National Renewable Energy Action Plans (NREAPs)

LIBERIA

Period 2015-2020/2030

Within the implementation of the

ECOWAS Renewable Energy Policy (EREP)

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Abbreviations and Acronyms

AA – Action Agenda
AME – Assistant Minister for Energy
AU – The African Union
BTG – Beyond the grid or off-grid systems or units
BWI – Booker Washington Institute in Kakata
CLSG – The Cote d'Ivoire-Liberia-Sierra Leone-Guinea transmission line project
CSGs – Civil Society Organizations
DDO – Distillate Diesel Oil
DFID – United Kingdom Department for International Development
DME – Deputy Minister for Energy
DOE – Department of Energy
ECOWAS – Economic Community of West African States
EDEEB – ECOWAS Directive on Energy Efficiency in Buildings
EE – Energy Efficiency
EEEP – ECOWAS Energy Efficiency Policy
EPA – Environmental Protection Agency
ERB – Energy Regulatory Board
EREP – ECOWAS Renewable Energy Policy
ERuEP – ECREEE Rural Electrification Program
ETC – Energy Technical Committee of the GOL
EU – European Union
EUEI-PDF – EU Energy Initiative – Partnership Dialogue Facility
EVD – Ebola Virus Disease Epidemic
Ex-Im – The U.S. Export-Import Bank
FAO – Food and Agriculture Organization
FAOSTAT – The FAO Statistical Database
FDA – Forestry Development Authority
FF – Fossil Fuel
FIT – Feed-in-Tariff
FSSs – Financial Support Schemes
GDP – Gross domestic product
GEF – Global Environment Facility
GEF – Global Environment Facility
GEF-SPWA – Global Environment Facility - Strategic Program for West Africa,
GHG – Greenhouse gas
GIS – Geographic information system
GIZ – Deutsche Gesellschaft für international Zusammenarbeit
GOL – Government of Liberia
GSA – General Services Agency
IDAE – Spanish Institute for Energy Diversification and Saving
IFC – International Finance Corporation
IPPs – Independent Power Producers
IPRSP – Interim Poverty Reduction Strategy Process
IRENA – International Renewable Energy Agency
LBR – Liberia Business Registry
LCL – Land Commission of Liberia
LEC – Liberia Electricity Corporation
LERC – Liberia Electricity Regulatory Commission
LHV – Low heating value
LNG – Liquefied Natural Gas
LRA – Liberia Revenue Authority
MCC – Millennium Challenge Corporation
MDGs – Millennium Development Goals

ML-HP – Medium to Large Hydro Projects
MLME – Ministry of Lands, Mines and Energy
MOA – Liberia's Ministry of Agriculture
MOL – Ministry of Labor
MPFDP – Ministry of Finance and Development Planning
MSW – Municipal solid waste
NEPL – National Energy Policy of Liberia
NIC – National Investment Commission
NOCAL – National Oil Company of Liberia
NRE – National Renewable Energy
NREAP – National Renewable Energy Action Plan
OPIC – Overseas Private Investment Corporation
PA – Power Africa
CSP – PV, Concentrated Solar Power
PIDA – Plan for Development of Infrastructure in Africa
PPA – Power Purchase Agreement
PPPs – Private Public Partnerships
PRS – Poverty Reduction Strategy
PSFM – Participatory and Sustainable Forest Management
PSP – Public Sector Partnership
PV – Photo Voltaic Solar Energy
RE – Renewable Energy
RE – Renewable Energy
RES – Renewable Energy Supplies
RREA – Rural and Rural Energy Agency
SEFA – Sustainable Energy Fund for Africa by the African Development Bank
SHP – Small Hydro Projects
SSHP – The ECOWAS Small-Scale Hydropower Program
SSREP – Small Scale Renewable Energy Program
UNDP – United Nations Development Program
UNEP – United Nations Environmental Program
UNICEF – The United Nations Children's Fund
US-ACEF – U.S. Africa Clean Energy Finance Initiative
USTDA – U.S. Trade and Development Agency

Units of Measure

dam^3 – cubic decameter or 1,000 m^3 or 10^6 L, described in some sources as a ML (Megaliter)
GWh – Gigawatt hour (10^9 Wh)
ha – hectare hm^3 – cubic hectometer or 1,000,000 m^3 or 10^9 L, described in some sources as a GL (Gigaliter) kg -kilogram kWh – kilowatt hour (10^3 Wh)
L – liter (decimeter or dm^3) m^3 – cubic meter
Mt – Megatonne (10^6 tonnes) MWh – Megawatt hour (10^6 Wh)
TJ – Terajoule (10^{12} J) Tonne -metric ton

NATIONAL RENEWABLE ENERGY ACTION PLAN (NREAP) OF LIBERIA

1.0 EXECUTIVE SUMMARY

This NREAP for Liberia 2015 presents the current situation of the renewable energy sector of Liberia, focusing on renewable energy, solar water heating, cooking fuels and technologies and bio-fuels, an examination of the current and immediate national energy policies, enabling legislative and regulatory environment as well as the institutional framework and players of the sector, highlighting the regulatory and ongoing program achievements and identifying remaining gaps. Current generation capacities, electricity access rates and the status of renewable energy in Liberia are presented.

The NREAP then presents in detail the planned targets, projections and scenarios for the trajectories determined through rigorous analysis using appropriate software tools to determine the targets and cost scenarios for the planned developments. Targets for the Action Plans include grid-connections, mini-grids, and introduction of modern domestic cooking fuels and equipment among others and increased access to electricity to both urban and rural areas. Also targeted are the development of the enabling policy, regulatory and legislative environment and institutional capacity and manpower development plans.

The NREAP goes on to advance appropriate measures for improved power generation as well as required standards for a rapid transformation of the electricity sector and acceleration of the involvement of all players including local community, civil society, government institutions, donor community and bi-lateral and regional energy institutions and the private sector investors, etc. in developments in the power sector.

Appropriate targets, priority measures and programs have been identified and advanced, as those actions required for meeting the targets for 2020/2030 will enable Liberia to achieve the required mandated targets to which Liberia has made commitments as member of ECOWAS, for the planning period. The follow-up national implementation coordination structure, analysis and monitoring framework as well as the required investments to accomplish this NREAP are also presented.

2.0 INTRODUCTION

The ECOWAS Renewable Energy Policy (EREP) and the ECOWAS Energy Efficiency Policy (EEEP) were adopted by the ECOWAS Member States in October 2012 and later by the ECOWAS Heads of States on 18 July 2013. The policy documents were prepared with technical support of the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE) and a broad range of international partners (UNIDO, EUEI-PDF, GEF-SPWA, Austria, and Spain). The policies include minimum targets and scenarios for renewable energy (RE) and energy efficiency (EE) and measures, standards and incentives to be implemented at both regional and national levels.

The EREP foresees the development of National Renewable Energy Action Plans (NREAPs) by the end of 2014 by all fifteen ECOWAS Member States. The five-year rolling NREAPs will contribute to the achievement of the regional EREP targets by 2020 and 2030. The NREAPs have been prepared by the ECOWAS Member States in accordance with a template provided by ECREEE. The NREAPs include baseline data on the status of renewable energy development, and propose attainable and renewable energy targets, including gender disaggregated indicators, based on national potentials and socio-economic assessments. Moreover, an overview on concrete laws, incentives and measures to be implemented by the country to achieve the targets are included. The implementation of Liberia's NREAPs will be monitored by the Ministry of Lands, Mines and Energy of Liberia and ECREEE on behalf of the ECOWAS Commission during a continued consultative process. The NREAP template was prepared with technical assistance of ECREEE and UNIDO. The NREAP development process has been supported by a broad range of partners such as the GEF–SPWA, GIZ, IRENA, the Governments of Austria and Spain.

3.0 SUMMARY OF CURRENT NATIONAL RENEWABLE ENERGY POLICY

The GOL has since 2009, placed priorities on accelerating the expansion of electricity access to the population and improve supply of reliable services essential for economic growth. Building upon the National Energy Policy of Liberia (NEPL) and the initial results achieved in rebuilding the electricity systems destroyed by the war, the GOL has an ambitious strategy to reach electricity coverage of at least 70 percent of the population in Monrovia, and 35 percent nationwide by 2025 and 100 percent nationwide by 2030.

The NEPL specifies policy objectives to establish an adequate delivery process for energy products and services through a public and private partnership where investments in new infrastructure and services are provided by the private sector to the greatest extent possible, including power sector transactions with the public sector providing the supporting policy environment as well as regulatory oversight. The NEPL expresses the GOL commitment to establish an independent and transparent regulatory process for the creation of an investment environment conducive to increased private sector involvement in the energy sector. Currently, the institutions in the electricity sub-sector in Liberia comprise: the Ministry of Lands, Mines and Energy (MLME), the Liberia Electricity Corporation (LEC) and the Rural and Renewable Energy Agency (RREA).

3.1 AN EXAMINATION OF THE 2009 ENERGY POLICY OF LIBERIA

In 2009, the GOL approved the **National Energy Policy of Liberia (NEPL) and Agenda for Action and Economic and Social Development.** The principal objective articulated in the National Energy Policy of Liberia is to ensure universal access to modern energy services in an affordable, sustainable and environmentally-friendly manner in order to foster the economic, political, and social development of Liberia.

For the period of June 2008 to June 2011 the Government of Liberia (GOL) adopted an overall vision and strategy for poverty reduction that was outlined in the documents: "Poverty Reduction Strategy (PRS) which built upon the 150-Day Plan of January 2006 and the "Interim Poverty Reduction Strategy Process (IPRSP)" for the period July 2006 to June 2008. Both documents were built on four pillars – (1) consolidating peace and security; (2) revitalizing the economy; (3) strengthening governance and the rule of law; and (4) rehabilitating infrastructure and delivering basic services. The development of the NEPL came about as an essential exercise towards the realization of the goals and objectives of the PRS as well as contributing to the achievement of the Millennium Development Goals (MDGs).

3.1.1 The 2009 NEPL Energy Access Targets

At the time of approval of the NEPL, the GOL reports that about **10%** of urban residents and less than **2%** of rural residents had access to electricity largely from self-generation (Non-LEC grid connected generation) using expensive imported fuel. The NEPL in 2009 predicted that by 2015, in line with the Millennium Development Goals (MDGs) as adopted by the Economic Community of West African States (ECOWAS), the Government expected to have achieved the following targets:

40% of Liberian citizens living in rural and peri-urban areas and using traditional biomass for cooking shall have access to improved stoves and kerosene or efficient-gas cookers in order to reduce indoor air pollution;

30% of the urban and peri-urban population shall have access to reliable modern energy services enabling them to meet their basic needs (lighting, cooking, communication, and small production-related activities);

15% of the rural population and 25% of the schools, clinics, and community centers in rural areas shall have access to modern energy services to meet the same basic needs. The long-term strategy is to make Liberia a carbon neutral country by 2050

The GOL committed to promote the use of renewable energy such as solar and wind systems in power plants and all large commercial facilities such as supermarkets, hotels, restaurants, entertainment centers, hospitals, and large retail shops and stores. The GOL through the dedicated Rural and Renewable Energy Agency (RREA) aimed to vigorously pursue the development of mini and micro hydro on the country's numerous rivers and streams for rural electrification. The policy further committed for the GOL to ensure the availability of quality

petroleum products on a cost recoverable, competitive, and affordable basis throughout the nation. In the long term, plans are that substitute renewable sources such as biodiesel shall be employed as fuel for transportation.

3.1.2 Quality Standards

The GOL in the NEPL committed to establishing quality standards for all energy products and services which will be monitored and enforced by the Energy Regulatory Board (ERB), which is planned to be established as contained in the 2015 Electricity Law of Liberia and the existing Bureau of Standards as appropriate; standards will be established to ensure accuracy of meters and gauges, product safety, security, reliability, consistency, purity, and availability as well as timeliness in responding to stakeholder service requests. The GOL shall also establish energy efficiency standards for all government and commercial buildings and industrial facilities and for importation of fuel-efficient vehicles and energy-efficient light bulbs and home appliances. It is the policy of the GOL to minimize and eliminate power loss, theft, and corruption in electricity generation, transmission and distribution and to promote international best practices in wholesale and retail energy transactions and in the granting of licenses and concessions for energy transactions.

3.1.3 Energy Cost and Efficiency Targets

The policy objective is to ensure affordability through least-cost production and utilization of energy services. The GOL supports the collective global effort to control harmful greenhouse gas (GHG) emissions responsible for climate change and will seek to balance the environmental costs and benefits of all energy programs.

The 2009 NEPL states that the GOL expects to achieve its access goals for **2015** while reducing GHG emissions by 10%, improving energy efficiency by 20%, raising the share of renewable energy to 30% of electricity production and 10% of overall energy consumption, and increasing the level of bio-fuels in transport fuel to 5%. No progress evaluation has thus far been made of this policy commitment. The GOL further committed to the provision of energy services on a full cost-recovery basis to those who are able to pay and on a targeted subsidized basis to those who can only afford to pay a portion of the cost. Prices will be set by the operators subject to costs allowed by the Energy Regulatory Board (ERB) now (National Electricity Regulatory Commission (NERC) and principles set by the Ministry of Lands, Mines and Energy (MLME) to ensure universal access. The Government will establish a regulatory process for monitoring all costs – economic, financial, social, and environmental – and allocating these to the user (rate payer or polluter) or public (taxpayer) as appropriate. This energy cost and efficiency targets policy is reaffirmed for this NREAP.

3.1.4 The Status of the 2009 NEPL as of November 2015

Up to the present (November 2015, the original NEPL target year, the majority of the above predicted targets have yet to be achieved and conversely, some of the gains made during the years since 2009 have been rolled back by many factors including the recent coming of the **Ebola Virus Disease Epidemic (EVD).**

Recently the GOL initiated concrete actions to change the electric power and renewable energy sector from the planning and emergency recovery stages and activities undertaken since 2006 following the fourteen (14) years civil war, into instituting transformation of the national regulatory and enabling environment for private sector driven power generation, transmission and distribution transactions and cross border electricity trade based on sustainable renewable energy resources and technologies. The GOL passed into law the RREA Act approved July 6, 2015 and published into handbills on July 15, 2015.

3.2 THE RREA ACT OF JULY 6, 2015

The GOL on July 6, 2015 fulfilled its commitment to facilitate and accelerate the economic transformation of rural Liberia by establishing a wholly government owned autonomous Rural and Renewable Energy Agency (RREA) dedicated to the commercial development and supply of modern energy services to rural areas with an emphasis on locally available renewable resources. In fulfilment of this policy, the Rural and Renewable Energy Agency (RREA) and the Rural and Renewable Energy Fund (RREFUND), which up to this year (2015) was constituted through executive order in January 2010 that had to be renewed annually has now been enacted into law.

The RREA's mandate includes integrating energy into rural development planning; promotion of renewable energy technologies; facilitating delivery of energy products and services through rural energy service companies (RESCOs) and community initiatives;

The RREA also has the mandate to facilitate and accelerate the economic transformation of rural Liberia by promoting the commercial development and supply of modern energy services to rural areas with an emphasis on locally available renewable resources. One of the RREA's principle functions is the planning and financing of rural energy projects for implementation by public, private and community developers. This includes educating the general public about renewable energy options and opportunities. The RREA is also mandated to manage a Rural Energy Fund (REFUND), a transparent financial management system through which all domestic and international resources intended for rural energy programs shall be managed in order to help achieve universal energy access in Liberia. Through the REFUND the RREA can provide low interest loans, loan guarantees, and grants as targeted subsidies to ensure access by the poor.

3.2.1 Objectives of the RREA

The objectives of the RREA as specified in the proposed Act creating it are as follows:

(a) To promote improved access to modern energy services in the rural areas of Liberia.

(b) To facilitate and accelerate the economic transformation of rural Liberia by promoting the development and supply of modern energy products and services to rural areas with an emphasis on locally available renewable resources.

(c) To introduce and promote the enactment of regulations and policies in the exercise of the functions of the Agency.

(d) To administer, secure, enforce, design and execute policies, strategies, plans and programs relating directly and indirectly to the functioning, growth and development of the rural energy sector.

3.2.2 Principles of Rural and Renewable Energy

The RREA Act provides for the following "Principles of Rural and Renewable Energy Development and Modern Energy Service Provision" to be recognized by the GOL as follows:

National Interest – to promote the general welfare, empowerment, and quality of life, and to support and sustain economic and social development;

Sustainability – to promote the development and use of economically, technically, socially, and environmentally viable and sustainable energy resources, including renewable energy, with emphasis on locally available resources in the rural energy sector;

Development – to promote, facilitate and support sustainable energy development through private and community initiative and involvement;

Productive Uses and Income Generation – to promote growth in economic production and productivity as well as social welfare through modern energy services to rural areas;

Equality – to provide energy services without undue discrimination among consumers;

Quality of Service, Safety, Efficiency and Continuity – to comply with applicable service quality, safety, reliability and efficiency norms and rules in force in energy services;

Coordination of Public Policies – to coordinate the requirements of energy policy with other policies that may be applicable to avoid inconsistent actions or directives;

Community Involvement – all relevant stakeholders will be encouraged to take active part in the decision making process to strengthen community ownership, households, commercial enterprises, social service facilities, administrative centres, etc.;

Conservation and Efficient Use of Natural Resources: Formulation and execution of the policy and principle of conservation and preservation of the environment will consistently be a consideration in the.

3.3 THE NEW 2015 ELECTRICITY LAW OF LIBERIA

In recent efforts to implement the GOL commitments in the NEPL, the President of Liberia submitted an electricity bill that plans to create a regulatory body instituting the above stated transformations. The GOL recently (August 2015) passed into law the 2015 Electricity Law of Liberia, which was given the final signature of the President of Liberia on October 23, 2015 and was printed into handbills on 26 October 2015. There is need for urgency and speed in the process of achieving the ECOWAS energy policy and SE4All goals of ensuring comprehensive access, doubling the current rate of efficiency improvements and doubling the share of renewable energy in the total energy mix as well as achieving GOL's strategic national energy policy objectives of cost effective and quality energy access for all, and creating the institutional reforms that provide the enabling environment for sustainable power sector development. These objectives are in line with the GOL's Agenda for Transformation (AFT). In July this year, the President appointed another Assistant Minister for Energy (AME) to fill the vacancy that has been there for nearly a year after the last AME departed. The 2015 Electricity Law provides for the elevation of the Energy Department to have a Deputy Minister for Energy (DME) that may be appointed in the near future in addition to the AME.

3.3.1 Purpose and Scope of the 2015 Electricity Law

The MLME has the mandate to develop national energy policies and master plans, and to administer, implement and enforce energy policy, as defined in the National Energy Policy. The purpose and scope of the 2015 Electricity Law is to establish the legal and regulatory framework for the generation, transmission, distribution and sale of electricity within the territory of the Republic of Liberia, and the import and export of the same. This law aims to facilitate the implementation of the National Energy Policy whose goals include but are not restricted to the following:

1. Expand on a sustainable basis the availability of electricity services with the goal of attaining universal access to electricity service;
2. Assure availability of supply and quality of service in electricity at reasonable and cost compensatory prices, fully cognizant of the need to balance affordability to customers with the need to attract capital and private investment to the sector;
3. Increase availability of electricity services needed to support economic development;
4. Promote the development of renewable energy resources for electricity generation;
5. Encourage efficient use of electricity resources and facilitate economic development;
6. Promote regional and international cooperation in electricity trade and investment;
7. Maintain a financially viable and sustainable electricity industry;
8. Establish and maintain transparency, accountability, and sound principles of governance in the electricity sector through appropriate institutional, market, and regulatory arrangements;
9. Provide the necessary capacity building process for electricity sustainability and security;
10. Ensure the security of the supply of electricity in Liberia;
11. Ensure the promotion of sustainable and fair competition in the electricity sector where it is efficient to do so;
12. Protect the interests of all classes of consumers of electricity as to the terms and conditions and charge of supply;
13. Ensure, so far as it is practicable to do so, the continued availability of electricity for use in public hospitals; and facilities for the disabled, aged and sick;
14. Ensure the availability of health and safety guidance in relation to electricity supply to the public;
15. Ensure the financial viability of efficient regulated electricity undertakings;

16. Ensure the collection, publication, and dissemination of information relating to standards of performance by licensed operators and on the electricity sector in Liberia for the use by the industry, consumers and prospective investors.;
17. Participate in regional and international matters relating to the regulation of electricity in Liberia;
18. Develop annual supply targets for the purpose of ensuring that such services are accessible to the widest number of electricity users; and
19. Achieve the aforementioned goals taking into account the protection of the environment and access to electricity for low income customers.

3.4 THE PROPOSED GOL POWER SECTOR DEVELOPMENT PLANS AND PROGRESS

The LEC Progress: The LEC has made small but significant progress to supply affordable power from the grid; to micro, small and medium enterprises (MSMEs); to industries and commercial enterprises; and to households in urban areas. LEC is working with partners to install heavy fuel oil (HFO) units at its Bushrod Island plant to increase capacity while the RREA is working with donors to develop a master plan for rural electrification including off-grid areas using small-scale solar and hydro-technologies. This will also entail consolidating the decision making process in the government, improving donor coordination, utilizing PPPs, and securing agreements from mining companies to invest in (or otherwise support) power generation not only for self-supply of their mining company facilities but also transmission from which other users can buy power. The RREA plans for the energy sector incorporate considerations for environmental sustainability, including reduced use of charcoal and wood for fuel by ensuring that most rural populations can get electricity as alternative to charcoal and firewood.

Agents and Process of Change: The GOL Energy Technical Committee (ETC), Liberian Electrical Corporation (LEC), the Rural and Renewable Energy Agency (RREA), the National Electricity Regulatory Commission (NERC), and the Department of Energy (DOE) of the MLME are working with development partners, investors, concessions and other stakeholders to plan, finance and carry out the reconstruction and rehabilitation of key power infrastructure for centralized generation and decentralized rural power supply. Decisions on design and implementation must be made jointly, through an iterative process. This consultation is being implemented as a part of the Rural Energy Master Plan process, and the process leading to this NREAP, NEEAP and SE4ALL Action Agenda for Liberia. The oil companies exploring offshore oil and natural gas in Liberia as well as major petroleum importers and distribution companies, will also play a meaningful role in the future trajectory of the energy sector of Liberia. If commercial deposits are discovered, especially gas discoveries which could be used for electric power generation, it is the policy of the GOL to discourage flaring of associated or non-associated produced LNG. Even if these do not come on-line until after 2025, they could have a major impact sooner on the energy planning and investments.

Outcome Indicators and Targets (by 2017): It is expected that more than 100,000 households and enterprises will have access to electric power at reduced costs and increased reliability. There will also be major increased safe access to petroleum fuel outside Monrovia and more access to modern non-solid fuels for cooking throughout the country that doesn't contribute to deforestation.

Priority interventions: Power sector investments planned under the GOL Agenda for Transformation (AfT) and incorporated under this NREAP-NEEAP-SE4All-AA include: rehabilitation of the Mount Coffee Hydro-electric plant; addition of back-up HFO generation capacity for the dry season when the power output from the Mount Coffee Hydro is low; completion of the main transmission backbones and distribution facilities for the main grid and inter-grid connections; and the CLSG connection under the West African Power Pool. The above mentioned key power sector institutions mandated to drive the power sector transformation agenda and the creation of the legal, regulatory and policy environment shall, as a priority be supported for technical and administrative capacity building and provided with the relevant supporting structures, staff and equipment, and the process of making the NERC functional and effective shall be given priority. The estimated cost of these priority investments total to more than US$ 600 million for the first five (5) years, a major part of which is expected to derive from Private Power Producers (PPPs) and international partners. The government will also arrange the installation of solar lights in over 10,000 villages.

Delays in building facilities for HFO storage and handling: In the interim period when HFO fuelled plants are an appropriate alternative for reducing the electricity production cost and at the same time bringing response to the demand increase and peaks installing facilities for HFO management is on the critical path. To accelerate the implementation of the projects already in the agenda of the Government and potentially funded by various donors in order that new plants are commissioned at the earliest, it is necessary that the rehabilitation of storage facilities progress expeditiously being mindful of the acute issues on the aspect of pollution and environmental impacts of spillage from HFO plants. More modern solutions are contemplated for the transport of HFO by pipeline.

Plans for Major Consumers of Power in Liberia: As the main consumers of power in Liberia, mining, agricultural and industrial companies will examine, together with the government, the possibilities and economic feasibility of building hydro-electric, solar PV, biomass, heavy-fuel and gas fired thermal generating plants. Because most of these facilities' output will be used by mining operations—as the power provisions of the concession agreements are finalized—they will be encouraged to build extra capacity and provide electricity to local enterprises and communities and eventually feed into the national grid at cost recovery prices. The relevant regulations governing power transactions involving concessions other than power as their main operations will be analyzed and where necessary, guidelines will be made.

Small Scale Off-Grid Thermal, Hydro and Solar Energy Development: Since most communities will remain off the grid in the immediate future, the government will support the RREA, IPPs and Private Investors in developing alternative options with small-scale thermal- hydro- solar- wind-energy and other efficient and renewable energy technologies. Currently, experiments with agriculture biomass for small diesel generators are being conducted (BWI) and others; as success energies from such pilots, the government will support their replication.

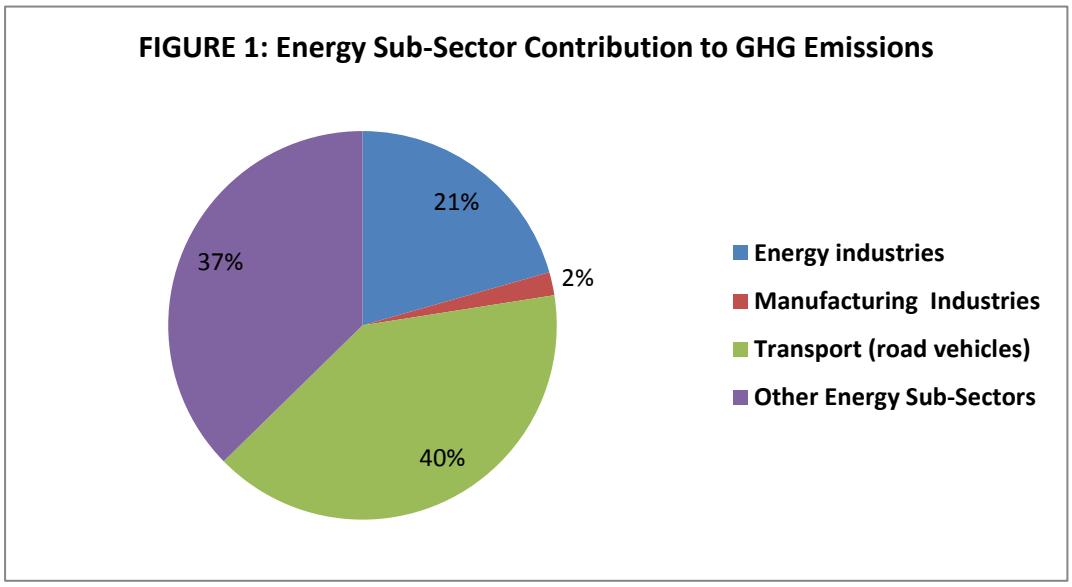
4.0 ENERGY SECTOR GREENHOUSE GAS EMISSIONS IN LIBERIA

The National Inventory of Greenhouse Gases of Liberia published by the Environmental Protection Agency (EPA) of Liberia indicates that in 2000, GHG emissions from the energy sector were 5,414 Gg CO_2 equivalents, which accounted for 67.5% of the total emissions in Liberia. CO_2 accounted for 66% of sectoral emissions, while CH_4 and N_2O contributed 28.3% and 5.7%, respectively. The GOL will support programs aimed at updating the GHG inventory statistics and the development of reduction and mitigation measures of GHG emissions in the energy sector. The energy industries subsector produced 20.6% of the emissions from the energy sector. The relatively low emissions (1.9 %) from manufacturing industries and construction reflect the low production and contribution of this subsector to the national economy. See Table 1 below for a summary of the 2000 statistics of GHG emissions for Liberia. Figure 1 below shows the graph of respective percentage share of contributions of GHG emissions from the Energy Sector.

TABLE 1: SUMMARY REPORT OF 2000 GHG EMISSIONS ESTIMATIONS FOR THE ENERGY SECTOR*

GHG Source and Sink Categories	CO_2 Gg CO_2 eq.	CH_4 Gg CO_2 eq.	N_2O Gg CO_2 eq.	Year 2000 Gg CO_2 eq.	Contribution To National Total (%)	Contribution To Sector (%)
Total National Sector GHG Emissions	3,571	4,141	310	8,022		
Energy Sector (in Gg and as percent of total energy sector emissions)	3,571 (66%)	1,533 (28.3%)	310 (5.7%)	5,414 (100%)		
Contribution of Energy to Total (%)					67.5%	
GHG emissions from fuel combustion (by sub-sector)						
1. Energy industries	1,117	0	0	1,117	13.9%	20.6%
2. Manufacturing industries and construction	105	0	0	105	1.3%	1.9%
3. Transport (road vehicles)	2,152	21	0	2,173	27.1%	40.1%
4. Other Energy Sub-Sectors	197	1,512	310	2,019	25.2%	37.3%

*SOURCE: EPA – LIBERIA'S INITIAL NATIONAL COMMUNICATION 2013



Transport (road vehicles) was the largest emitting category in 2000, contributing 40.1% to total sectoral GHG emissions. The majority of the vehicles in Liberia are dilapidated and poorly maintained, inefficiently consume low-grade fuel, and are forced to use bad roads. Other Energy Sub-Sectors (including energy for residential, agricultural, and commercial uses) come second with 37%, while energy industries such as electricity generation come third with 21%. Manufacturing industries are the least emitting sources with 2%. Sources of emissions include fossil fuel combustion and burning of biomass (firewood and charcoal).

5.0 INSTITUTIONAL FRAMEWORK

5.1 MINISTRY OF LANDS, MINES AND ENERGY (MLME)

The MLNE was established by an Act of Legislature in 1972 to administer all activities related to land, mineral, water and energy resources exploration, coordination and development in Liberia. In adherence to its statutory mandate, the Ministry formulates and implements policies and regulations in collaboration with other sector related agencies for the delivery to the public, efficient services from the land, mineral, water and energy sectors. The three functional areas of the Ministry - lands, minerals and energy - are clustered under a Deputy Minister for Operations.

The 2009 NEPL commits the GOL to reorganizing the MLME to elevate the attention given to energy and its many uses and benefits and ensures that the Ministry's Department of Energy (DOE) is organized efficiently and resourced adequately to discharge its oversight role over all the different energy sub-sectors as well as to direct and supervise, through policy making and planning, the efficient development of the energy sector as a whole.

5.1.1 The Department of Energy (DOE), MLME

The Department of Energy (DOE) under the MLME has an oversight role over all the different energy sub-sectors, as well as the mandate to direct and supervise, through policy making and planning, the efficient development of the energy sector as a whole. The DOE is headed by an Assistant Minister for Energy and consists of the Bureau of Hydrocarbons and the Bureau of Energy Technology and Policy Development (presently called Bureau of Alternative Energy). MLME and DOE play an essential policy guidance role, complementing other players such as the LEC, NOCAL, and RREA in the energy sector. The MLME is part of the Board of Directors of LEC, NOCAL and RREA.

Presently the Bureau of Hydrocarbon has since 2000 been dissolved and the National Oil Company of Liberia (NOCAL) was created to take the functions of the Bureau of Hydrocarbon. This left the Department of energy

with only the Alternative Energy Bureau. With the creation of the RREA, the remaining functions of the Department of Energy performed by the Alternative Energy Bureau are effectively transferred to the RREA leaving this Bureau's mandate for the energy sector effectively undefined other than being member on the respective boards.

Up to the present, the DOE is still headed by an Assistant Minister for Energy and not yet elevated to the Deputy Minister status as planned in the 2009 NEPL. Secondly, the position of Assistant Minister remained unoccupied for some time. A recent development has seen the appointment of an AME, who has yet to take office; the DME position has been created with the entry into force of the 2015 Electricity Law.

The general situation is therefore that the current institutional framework has some gaps and does not fit with challenges and requirements of the projected national energy policy and strategy. It is therefore a part of this plan for DOE to be staffed with engineers, technician and consultants and reorganized taking into account the challenges, tasks and deadlines deriving from this NREAP, NEEAP and the SE4ALL Action Agenda strategy adopted by the Government.

As a part of the staffing and training process for the DOE it should be a requirement to be embedded into a Technical Assistance program. A first expert recruited internationally will train and transfer knowledge to local staff. Supporting administrative staff and office resources must be mobilized simultaneously. The transfer of knowledge and training of the local staff in the procedures and practices in the fields of project appraisal, international procurement of goods and services, consultancy services contracts, tender documents analysis and bid evaluations in the power sector is a must. This staff must be permanently based at the DOE and fully dedicated to the task of liaising with the community of donors.

5.1.2 Energy Regulatory Board (ERB) and Liberia Electricity Regulatory Commission (LERC)

The NEPL commits the GOL to balance the interests of consumers with those of firms engaged in the importation, production, transportation, distribution, and sale of energy products and services through the creation of an autonomous regulatory body, enabled by legislation, to eliminate distortions in energy-related markets through transparent, predictable and stable oversight; the Energy Regulatory Board (ERB) when created, shall be responsible for monitoring all energy policies and standards established by the MLME. In fulfilment of this policy, the new 2015 Electricity Law provides for the appointment by the President, a *Liberia* ***Electricity Regulatory Commission (LERC)*** **("Regulator")** which shall consist of a chairperson and two members, appointed by the President with the consent of the Senate.

The Regulator shall have the authority beginning three (3) years after the electricity Law comes into effect with functions including to investigate alternative forms of regulation such as flexible tariffs, incentive based regulations, and the use of competitive markets. The Regulator may adopt one or more alternative methods of regulation following such investigation upon a finding made using an open and transparent process that the use of alternative forms of regulation will fulfil the purposes of this law and will result in rates that are just and reasonable for consumers and compensatory for licensees.

The LERC shall initially reside within the Ministry for administrative purposes and shall be independent with respect to its budget, management, staffing and in the exercise of its duties and authorities. Notwithstanding its independent role, LERC shall work closely with the Ministry during the transition period described of three years to ensure that the transfer of authority is conducted in a smooth manner and that employee transfers, if any, are coordinated to serve the needs of both LERC and the Ministry.

The LERC shall be an independent agency and shall act independently from any regulated entity and shall not seek or take directions from any Government or public or private entity when carrying out its regulatory tasks other than as required under this Law. LERC shall be qualified, within the scope of its legal authority and jurisdiction, to make final adjudicatory and administrative decisions, subject only to the appellate process.

5.2 LIBERIA ELECTRICITY CORPORATION (LEC)

The Liberia Electricity Corporation (LEC) is a public corporation, established in 1973, with the responsibility for generation, transmission and distribution of electricity throughout Liberia. To ensure the efficient operation of LEC after the war, a five-year management contract was signed between LEC, the Ministry of Lands, Mines, and Energy (MLME), and Manitoba Hydro International (MHI). For background information e.g. on RE potentials as well as details of the RE policy, programs, plans, other stakeholders etc. please refer to the baseline report that will be published on the ECREEE website.

6.0 SUMMARY OF THE PRESENT POWER GENERATION CAPACITY

6.1 CURRENT STATUS OF RENEWABLE ENERGY PENETRATION IN 2010

This section presents the current status of primary and renewable energy penetration in 2010 and specifies the targets Liberia intends to achieve by 2020 and 2030 as contribution to the attainment of the targets of the ECOWAS Renewable Energy Policy (see targets in the EREP document).

The primary energy consumption by fuel type is shown in table 2 below. In 2010 firewood represented approximately 84% of the total energy; charcoal came second with a little over 9% and petroleum products for all purposes including transportation and that used for electricity generation amounted to about 6; while the rest (Including small scale hydro) total to slightly less over 1%.

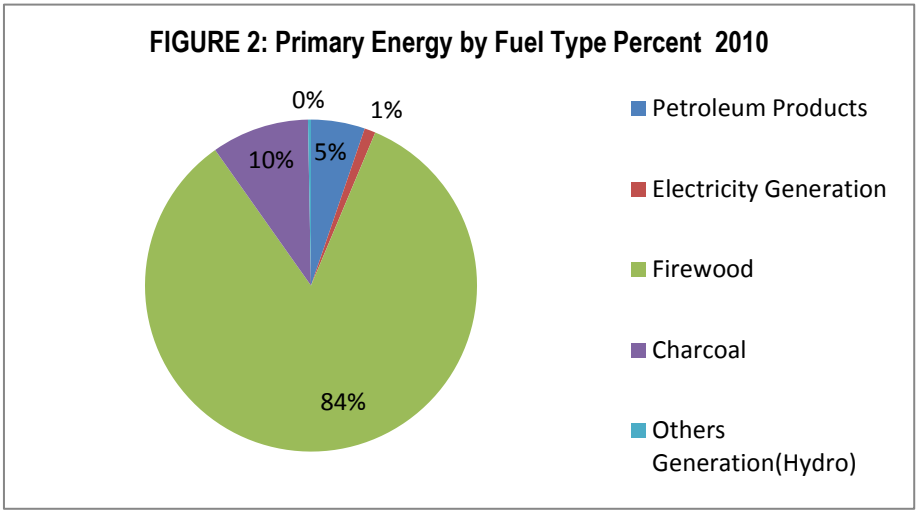
TABLE 2: PRIMARY ENERGY CONSUMPTION BY FUEL TYPE, 2010

	GWh	PERCENT
Petroleum Products	727	5.2%
Electricity Generation (fossil fuel)	150	1.1%
Firewood	11,613	83.9%
Charcoal	1,316	9.5%
Others Generation (Hydro)	40	0.3%
TOTAL	**13,845**	**100.00%**

The current primary energy situation in Liberia is characterized by a dominance of traditional biomass consumption and low access to poor quality and relatively expensive modern energy services. Over 95% of the population of the low income category relies on firewood, charcoal, and palm oil, candles and kerosene for their cooking and lighting energy needs. Firewood and charcoal consumption together constitute over 93% of the energy mix. Figure 2 below presents the picture of the relative share of primary energy by fuel type in Liberia by in 2010.

Electricity generation from renewable energy including small-medium-scale hydro accounted for 21% of total electricity production in 2010. Modern energy services based on electricity and petroleum products are predominantly used for economic production, electricity generation and transportation, and mainly in the Monrovia area.

FIGURE 2: Primary Energy by Fuel Type Percent 2010



6.2 ELECTRIC POWER SECTOR (INSTALLED CAPACITY, ANNUAL GENERATION, IMPORT/EXPORT)

The table 3 below gives the estimated electric power generation capacity for 2010 by type of fuel.

TABLE 3: INSTALLED CAPACITY (2010)			ESTIMATED GENERATION	
Fuel Type	**MW**	**% of Total**	**GWh**	**%**
Hydro	4.6	21%	40.0	21%
HFO	2.3	11%	20.1	11%
Diesel	14.33	66%	125.5	66%
Gasoline	0.5	2%	4.4	2%
TOTAL	**21.7**	**100%**	**190.0**	**100%**

The current (2010) installed LEC electric grid generation capacity in Liberia is approximately 22 MW distributed as follows: Hydropower, 21%; thermal (HFO) capacity, 11%; thermal (diesel) 66% and thermal (gasoline) 2% of the total installed capacity in Liberia. Power generation for 2010 is estimated at 190 GWh, distributed in approximately the same proportions.

6.3 THE 2015 ASSESSED SELF-GENERATION (NON-LEC GRID CONNECTED) CAPACITY

The 2015 assessed self-generation (non-LEC grid connected) electric power capacity in Liberia highlights the problem of low access to grid-connected electricity from LEC. An assessment showed that the current non-LEC, self-generation capacity is estimated to be about 66% of current total electric power generation capacity in Liberia, (i.e. the total 2015 generation capacity is 139.8 MW including LEC's capacity of 48 (MW) earlier estimates in 2010 was around 80% of the 113.5 MW total capacity in 2010. The gap between grid-connected power supply and that produced by standalone self-generation systems is still wide. Informal independent power producers (IPPs) are beginning to emerge. There is a need to accelerate the creation of the enabling environment, electricity laws, regulations and institutional structures required to formalize/legalize these developing independent producers. One benefit from formalizing the IPPs is their positive impact on the increase in the rate of access to electricity for the population. While we encourage the development of IPPs, the need to increase the efficiency of power production by way of improved production technologies and by accelerating the rate of renewable energy in the power production mix and environmentally sustainability power production cannot be overemphasized. See figure 3 below.

FIGURE 3: 2015 SELF-GENERATION CAPACITY [%]

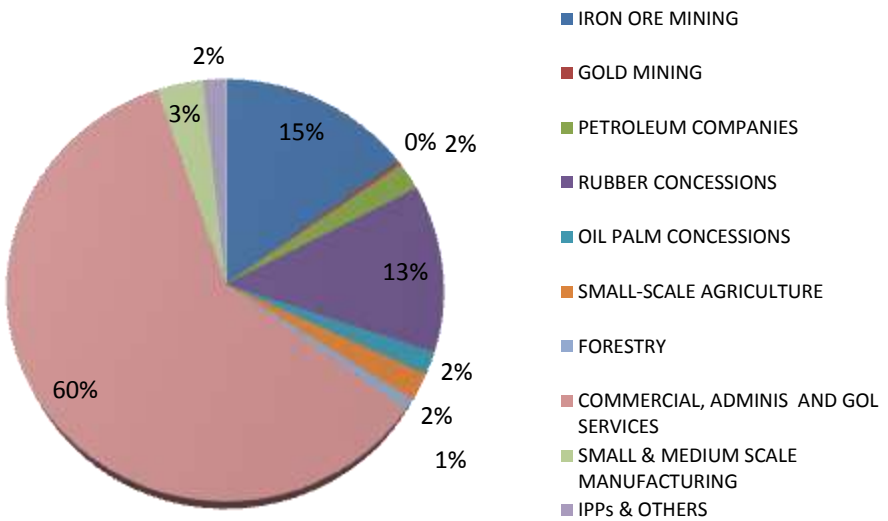


Table 4 below gives a summary of the self-generation capacity distribution. The initial total for the 2015 self-generation capacity assessed is approximately 91.78 MW. The highest share of self-generation (59.8%) originated from the small-scale industries, commercial, administrative and GOL services. The second highest (14.9%) was from the iron ore mining sector, and the third was the rubber concessions (12.8%). A graph of the percentage distribution of the self-generation capacity is shown in Figure 3 above.

TABLE 4: 2015 SELF-GENERATION CAPACITY OF ELECTRIC POWER BY CATEGORY (utilizing mainly diesel)

SUMMARY	CAPACITY (MW)	PERCENTAGE OF TOTAL SELF-GENERATION CAPACITY
Iron Ore Mining Concessions	13.71	14.9%
Gold Mines	0.29	0.3%
Petroleum Companies	1.95	2.1%
Rubber Concessions	11.75	12.8%
Oil Palm Concessions	1.63	1.8%
Small-Scale Agriculture	1.96	2.1%
Forestry	0.79	0.9%
Small Scale Industries, Commercial, Administrative And GOL Services	54.90	59.8%
Small & Medium Scale Manufacturing	3.23	3.5%
IPPs & Others	1.59	1.7%
GRAND TOTAL	**91.78**	**100.0%**

7.0 TARGETS FOR GRID CONNECTED RE 2010, 2020 AND 2030

The calculated targets for grid connected RE by 2015, 2020 and 2030, based on the NREAP-NEEAP-SE4ALL Scenarios Tool and parameters chosen by the Liberia NREAP Project Team, are shown in Table 5 below. The input values for the calculation parameters of the scenarios and trajectories are in Appendix III. According to the set targets, the baseline Grid Connected Power Generation for 2010, 2015, 2020, 2025 and 2030 amounts to 190GWh, 242GWh, 309GWh, 395GWh and 505GWh respectively of which about 40GWh each comes from Renewable Energy generation. The implementation of the NREAP will make additional power generation available from hydro power, wind, PV and other renewable (mainly biomass). The NREAP Scenario results indicate that there will be more than sufficient power generation available from the RE sources to replace the projected grid power generation capacity from fossil fuelled sources.

7.1 TARGETS FOR GRID CONNECTED RENEWABLE ENERGY

TABLE 5: TARGETS FOR GRID CONNECTED RENEWABLE ENERGY

	2010	2015	2020	2025	2030
Annual electricity generation (GWh)	190.00	242.49	309.49	395.00	504.13
of which renewable generation (GWh)	39.51	39.51	39.51	39.51	39.51
Scenario NREAP					
Additional hydropower generation (GWh)	-	-	1,950.00	3,900.00	3,900.00
Additional wind generation (GWh)	-	-	0.16	0.31	0.31
Additional PV generation (GWh)	-	-	225.00	450.00	450.00

TABLE 5: TARGETS FOR GRID CONNECTED RENEWABLE ENERGY					
	2010	2015	2020	2025	2030
Additional renewable electricity generation (GWh)	-	-	2,175.16	4,350.31	4,350.31

Table 6 below shows the electric power installed capacity (including medium scale hydro) in MW. The Renewable Energy Share of the total Grid Connected Electricity Power Generation Mix (including medium and large hydro) will constitute only 13%, 10% and 8% respectively in 2020, 2025 and 2030. However, with the NREAP Measures as stated in table 5 above, the RE share is expected to constitute the greater share of the generation with a mix of generation from various RE resources. Total Grid Connected Electric Power Installed Capacity for 2010 and 2015, is 22MW and 28MW respectively and is targeted to rise to about 36MW in 2020, 46MW in 2025 and 58MW in 2030. In addition, a constant capacity of 4.6MW RE mainly medium and large scale hydro is projected for each of the years.

TABLE 6: TARGETS FOR GRID CONNECTED INSTALLED CAPACITY AND GENERATION AND SHARE OF RE					
IN MW INSTALLED CAPACITY	2010	2015	2020	2025	2030
Total Grid Connected Electric Power Installed Capacity (including large and medium scale hydro) (MW)	21.99	28.07	35.82	45.72	58.35
Renewable Energy Share of Total Grid Connected Electric Power Installed Capacity (including large and medium scale hydro) (MW)	4.57	4.57	4.57	4.57	4.57
Renewable Energy Share of the Total Grid Connected Electric Power Installed Capacity (including large and medium scale hydro) (%)	21%	16%	13%	10%	8%
Total Grid Connected Electric Power Generation (including large and medium scale hydro) (GWh)	190	242.49	309.49	395.00	504.13
Renewable Energy Share of the Total Grid Connected Electric Power Generation (including medium and large hydro) (GWh)	39.51	39.51	39.51	39.51	39.51
Renewable Energy Share of the Total Grid Connected Electricity Power Generation Mix (including medium and large hydro) (%)	21%	16%	13%	10%	8%

Rural populations receiving access to electricity through grid and stand alone, but largely through the use of off-grid or mini-grid electric power applications will increase from the 2010 level of 0.3% to 34.5% in 2020 and 100% (*universal access*) in 2030.See table 7 below.

7.2 TARGETS FOR OFF-GRID APPLICATIONS

TABLE 7: TARGETS FOR OFF-GRID APPLICATIONS			
	2010	2020	2030
Share of Rural Population Served with Off-Grid (mini-grids and stand-alone) Renewable Energy Electricity Services in %	0.3%	34.5%	100%

7.3 DOMESTIC COOKING UTILIZING IMPROVED COOK-STOVES TECHNOLOGIES

Domestic cooking utilizing improved cook-stoves technologies and the use of efficiently consuming charcoal stoves technologies are planned to be introduced, promoted and encouraged extensively over the planning period. The set targets therefore are presented in tables 8a and 8b below. The share of population targeted for using modern cooking devices is projected to increase from 26% in 2010 and 2015 to achieve universal access to modern cooking ("Cooking Plan") and efficient cook-stoves to 49% in 2020, 72% in 2025 and finally arriving to

95% in 2030. The use of measures to achieve universal access to modern cooking ("Cooking Plan") and efficient cook-stoves technologies is projected to raise the targets for the share of population using improved cook-stoves by more than double from the constant 15% rate in the baseline scenario in 2020, 2025 and 2030 to 36% in 2020 37% in 2025 and up to 38% in 2030. See tables 8a and 8b below.

7.3.1 Targets For Domestic Cooking Energy

TABLE 8a: TARGETS FOR DOMESTIC COOKING ENERGY

	2010	2015	2020	2025	2030
Share of Population Using Improved Cook-Stoves in %	15%	15%	15%	15%	15%
Share of households using an alternative technology (%)	1%	1%	1%	1%	1%
Share of households using LPG (%)	10%	10%	10%	10%	10%
Total families using modern cooking devices (%)	26%	26%	26%	26%	26%

7.3.2 Scenario With Measures to Achieve Universal Access to Modern Cooking, "Cooking Plan"

TABLE 8b: SCENARIO WITH MEASURES TO ACHIEVE UNIVERSAL ACCESS TO MODERN COOKING, "COOKING PLAN"

	2010	2015	2020	2025	2030
Share of Population Using Improved Cook-Stoves in %	15%	15%	26%	37%	48%
Shareof households using an alternative technology (%)	1%	1%	2%	4%	5%
Share of households using LPG (%)	10%	10%	21%	32%	43%
Total families using modern cooking devices (%)	26%	26%	49%	72%	95%

7.4 PROJECTED MODERN COOKING

The table 9 below from the Scenario results present the numbers of thousands of households for the baseline compared to the scenario with measures for access to modern cooking for the selected years (2010, 2020, 2025 and 2030). The required investments to achieve these targets are calculated to amount to approximately 99.3 million Liberian dollars ($1.24 million US dollars).

TABLE 9: PROJECTED MODERN COOKING					
Year	2010	2015	2020	2025	2030
Baseline Scenario ("Baseline") for cooking					
Total number of households (000)	**712**	**786**	**868**	**958**	**1,058**
No. of households using LPG (000)	71	79	87	96	106
No. of households using an improved cookstove (000)	107	118	130	144	159
No. of households using an alternative technology (000)	7	8	9	10	11
Total: families using modern cooking devices, baseline scenario (000)	**185**	**204**	**226**	**249**	**275**
Scenario with measures to achieve universal access to modern cooking, "Cooking Plan"					
No. of households using LPG (000)	71	79	182	305	453
No. of households using an improved cookstove (000)	107	118	225	353	506
No. of households using an alternative technology (000)	7	8	20	34	50
Total: families using modern cooking devices, baseline scenario (000)	185	204	426	692	1,009
Annual investment LPG (000 000 Liberian Dollar)	0.00	0.94	4.03	5.71	7.68
Annual investment improved cookstove (000 000 Liberian Dollar)	0.00	0.14	0.46	0.63	0.83
Annual investment alternative technology (000 000 Liberian Dollar)	0.00	0.09	0.45	0.64	0.86
Total investment (000 000 Liberian Dollar)	**99.33001**				

7.5 TARGETS FOR SOLAR WATER HEATERS

The targets for Solar Water Heaters have been set to increase from zero in 2010 to approximately 17,400 in use around the country in 2020 and up to approximately 52,900 in 2030.

TABLE 10: TARGETS FOR SOLAR WATER HEATERS

	2010	2020	2030
No. of Residential Houses With Solar Thermal Systems (000)	0	17.4	52.9
Share of District Health Centers, Maternities, School Kitchens And Boarding Schools With Solar Thermal Systems in %	0%	5%	10%
Share of Agro-Food Industries (Preheating of Process Water) With Solar Thermal Systems in %	0%	5%	15%
Share of Hotels With Solar Thermal Systems in %	1%	10%	15%

7.6 TARGETS FOR BIO-FUEL USE AS FUEL

Bio-fuel use as fuel (in the form of biodiesel and ethanol) has been assessed to have a substantially high potential in Liberia (The tool does not mention bio-fuels so we referenced the Assessment of Biomass Resources in Liberia by NREL). Therefore it is envisaged to raise the percentage share from 0% in 2010 to 2% in 2020 and up to 5% in 2030 in accordance with the target set in the 2009 NEPL. See Table 11 below.

TABLE 11: TARGETS FOR BIO-FUELS

	2010	2020	2030
Bio-fuels (1st Generation) Ethanol as Share of Gasoline Consumption Biodiesel as Share of Diesel and Fuel Oil Consumption	0%	2%	5%

7.7 RENEWABLE ENERGY TARGETS AND TRAJECTORIES

7.7.1 Grid-Connected Renewable Energy Targets

This section presents Liberia's grid-connected targets for the share of renewable energy in the national electricity mix in 2010, 2015, 2020, 2025 and 2030. The targets herein decided upon will contribute to the achievement of the set targets in the ECOWAS Renewable Energy Policy (EREP) to which Liberia is a signatory. The methodology used to determine these targets is based on the Scenario Tool for NREAP-NEEAP-SE4ALL. The base year selected is 2010 and the year 2016 has been selected as the year in which the execution of the NREAP, NEEAP and SE4ALL plans will commence. *Appendix III* to this document gives the Calculation Parameters for the Scenarios NREAP-NEEAP-SE4ALL. Table 12 below presents a summary - overview of the scenario NREAP-NEEAP-SE4ALL electric power generation capacities for the baseline scenario case in comparison with the scenarios with measures to introduce a combination of renewable energy (RE), energy efficiency (EE) and SE4All action agenda plans in Liberia for the selected target years. Annual electricity generation (GWh/year) is presented for the respective scenarios. In addition, the projected rates of electricity access to the population are also presented. The detailed analyses of these results as well as graphical comparisons are presented in the figures that follow below for the four cases scenarios (Baseline, RE, EE and SE4All measures) when these measures are introduced in the power production sector.

(Note: The Scenarios Tool is taking into account all local conditions (favorable/unfavorable) including but not limited to: cost of alternative fossil based technologies; willingness and ability of users to pay for the energy; local technical capacity; availability of public and private capital, etc.; Average consumption per household of fossil fuels - such as kerosene, oil, fusel based electricity, etc. - for lighting and other energetic uses; Expenses for purchase of fossil fuels, as percentage of total power sector costs is assumed to be 50%)

7.8 OVERVIEW OF THE SCENARIO NREAP - NEEAP - SE4ALL

TABLE 12- OVERVIEW OF THE SCENARIO NREAP - NEEAP - SE4ALL					
Baseline scenario ("Baseline") for the power sector of Liberia					
YEAR	2010	2015	2020	2025	2030
Annual electricity generation (GWh)	190	242	309	395	504
of which renewable generation (GWh)	40	40	40	40	40
Rate of access to electricity	1.40 %				
Scenario NREAP - NEEAP - SE4ALL					
Additional renewable electricity generation (GWh)	0	0	2,175	4,350	4,350
Savings in electricity consumption (GWh)	0	0	165	369	590
Efficiency + renewables (GWh)	0	0	2,340	4,719	4,941
Estimated reduction of GHG emissions (in thousands of tCO_2 eq)	0	0	936	1,888	1,976
Rate of access to electricity	1.40 %	1.40 %	34.20 %	67.10 %	100.00 %

7.8.1 The Access Rate

Following the NREAP-NEEAP-SE4ALL implementation, electricity access as percent of the population receiving access to electricity which stands at 1.4% for 2010 and 2015 is projected to rise to 34.2% in 2020 and by 2025 it will reach to 67.1% and is targeted to reach universal access of 100% supply of electricity from various sources. For the baseline scenario, the power production for 2015 is projected to increase by 2.2 times that of 190GWh for 2010 and by the same proportion of that for 2015 to achieve the 2020 target and 2030 respectively. This amounts to a 120% five year increase or 24% per year.

7.8.2 Scenario With Simultaneous Introduction of RE-EE-SE4All Measures

The simultaneous introduction of RE-EE-SE4All measures will make available even greater levels of electric power generation growth rates trajectory..
See the overview of the scenarios analysis Table 13 below.

7.9 COMPARATIVE OVERVIEW OF THE SCENARIOS

The overview results for the years 2010, 2015, 2020, 2025 and 2030 are on the below table 13 (RE - Overview of Scenario NREAP). As repeated in table 12 below, the Renewable Energy Share of Total Grid Connected Electric Power Generation (including large and medium scale hydro in GWh) declines from 21% in 2010 to 16% in 2015 down to 13% in 2020 then to 10% and 8% in 2025 and 2030 respectively. The introduction of renewable energy in the power generation mix for Liberia will make available an additional 4,350GWh in the year 2020; 8,700GWh in 2025; and 8,700GWh in 2030. This additional electric power generation would come from additional hydroelectric power, other renewable energy systems; wind energy, and solar photovoltaic (PV) mini-grids, and standalone power systems. This represents an increase in the share of renewable energy in the total electricity generation mix from 13% to 93% in 2020 and from 10% share to 96% in 2025 and from 8% share to 95% of the total power generation for the year 2030. See table 12 below.

TABLE 13 - RE - OVERVIEW OF SCENARIO FOR NATIONAL RENEWABLE ENERGY ACTION PLAN (NREAP)					
YEAR	2010	2015	2020	2025	2030
Baseline scenario ("Baseline") for the power sector of Liberia					
Annual electricity generation (GWh)	190.00	242.49	309.49	395.00	504.13
of which renewable generation (GWh)	39.51	39.51	39.51	39.51	39.51
Renewable Energy Share in the Generation Mix	21%	16%	13%	10%	8%
Scenario NREAP					
Additional hydropower generation (GWh)	-	-	1,950.00	3,900.00	3,900.00
Additional wind generation (GWh)	-	-	0.16	0.31	0.31
Additional PV generation (GWh)	-	-	225.00	450.00	450.00
Additional renewable electricity generation (GWh)	-	-	2,175.16	4,350.31	4,350.31
Total Additional RE Generation (GWh)	-	-	4,350.31	8,700.63	8,700.63
Additional Renewable Energy Share in the Total Electric Power Generation Mix	0%	0%	93%	96%	95%
Remaining Generation (Fossil Fuel) GWh	150.49	202.98	269.98	355.49	464.62

7.10 SAVINGS FROM ENERGY EFFICIENCY

The total additional energy available from the implementation of energy efficiency (EE) measures is presented in table 14 below. The total savings in energy consumption amounts to 165GWh; 369GWh and 590GWh in 2020; 2025 and 2030 respectively. The energy efficiency savings of 165GWh in 2020, 369GWh in 2025 and 590GWh in 2030 will be enough to replace or avoid the remaining fossil fuel generation (see bottom line of table 13 above) by 61% in 2020 and more than 100% replacement or avoidance of fossil fuel generation before or by 2025 and onwards to 2030 and beyond. See table 14 below,

TABLE 14: EE - OVERVIEW OF SCENARIO FOR NATIONAL ENERGY EFFICIENCY ACTION PLAN (NEEAP)					
YEAR	2010	2015	2020	2025	2030
Baseline scenario ("Baseline") for the power sector of Liberia					
Annual electricity generation (GWh)	190.00	242.49	309.49	395.00	504.13
Scenario NEEAP					
Savings through the reduction of losses in the electric grid (GWh)	-	-	30.95	71.10	90.74
Savings in domestic and public lighting (GWh)	-	-	116.00	251.16	412.73
Savings in the building sector (GWh)	-	-	11.61	29.62	56.71
Savings in the industry sector (GWh)	-	-	6.63	16.93	30.25
Total EE savings in electricity consumption (GWh)	-	-	165.19	368.81	590.43

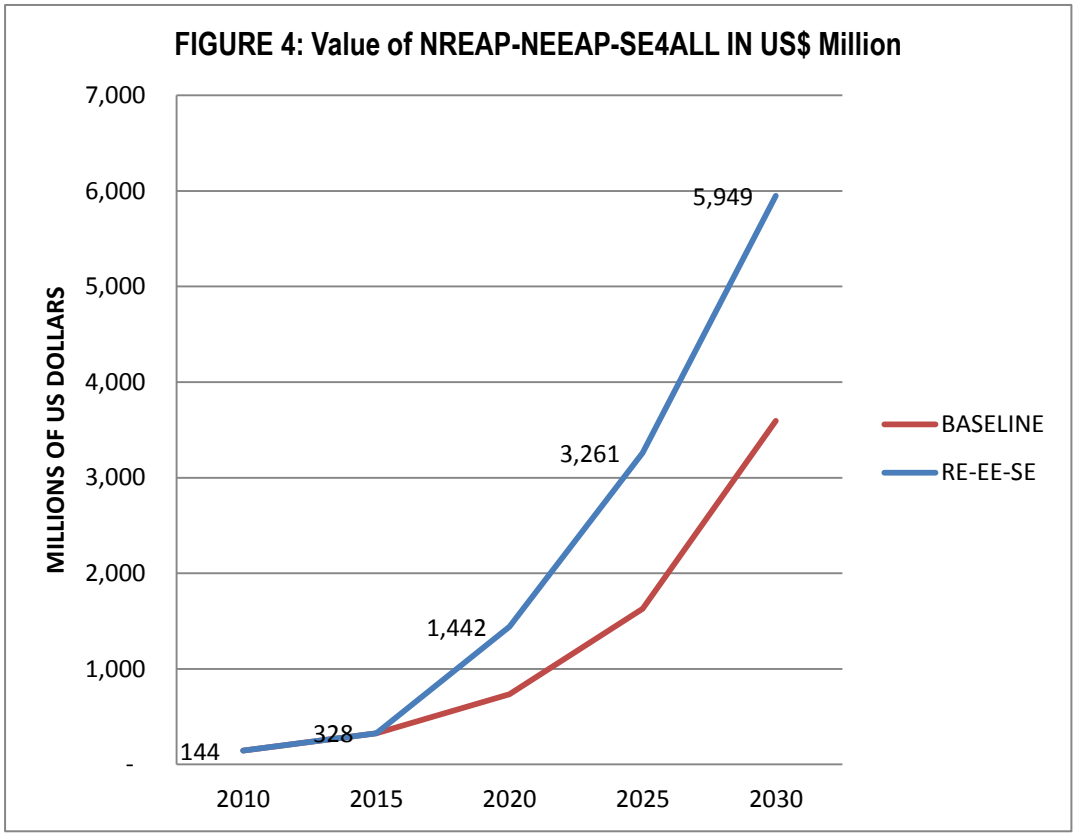
8.0 VALUE OF REQUIRED INVESTMENTS

8.1 VALUE OF ELECTRIC POWER GENERATION AND REQUIRED INVESTMENTS

Table 15 below presents the projected value of the required investments to achieve the projected capacity and power generation targets. The electricity access rate is expected to rise from the lowest in the sub-region (1.4% of the population in 2015) to 34.2% of the population by 2020; 67.1% in 2025 and finally to 100% (universal access) by 2030. At the current (2010) exchange rate of L$80 to US$1, the total investments needed amount to US$144 million in 2010, US$328 for 2015, US$1.44 billion in 2020, US$3.3 billion in 2025 and US$5.95 billion in 2030. This amounts to an average annual investment of US$556.20 Million to achieve the planned targets over the 20 years planning period (2010-2030). The projected annual investments are shown on the below trend graph, Figure 4.

Figure 4 below demonstrates the trajectories of financial investments for the baseline scenario as compared to the RE-EE-SE4All trajectory when the appropriate measures for power generation and sectorial development are introduced. The baseline scenario predicts annual average investments of US$321.45 for the 20-year planning period; however, this will not meet the desired universal access targets until the annual investments include the introduction of the NREAP-NEEAP-SE4All action agenda which will require more than doubling (2.21 times) the baseline annual investments to US$556.20 Million.

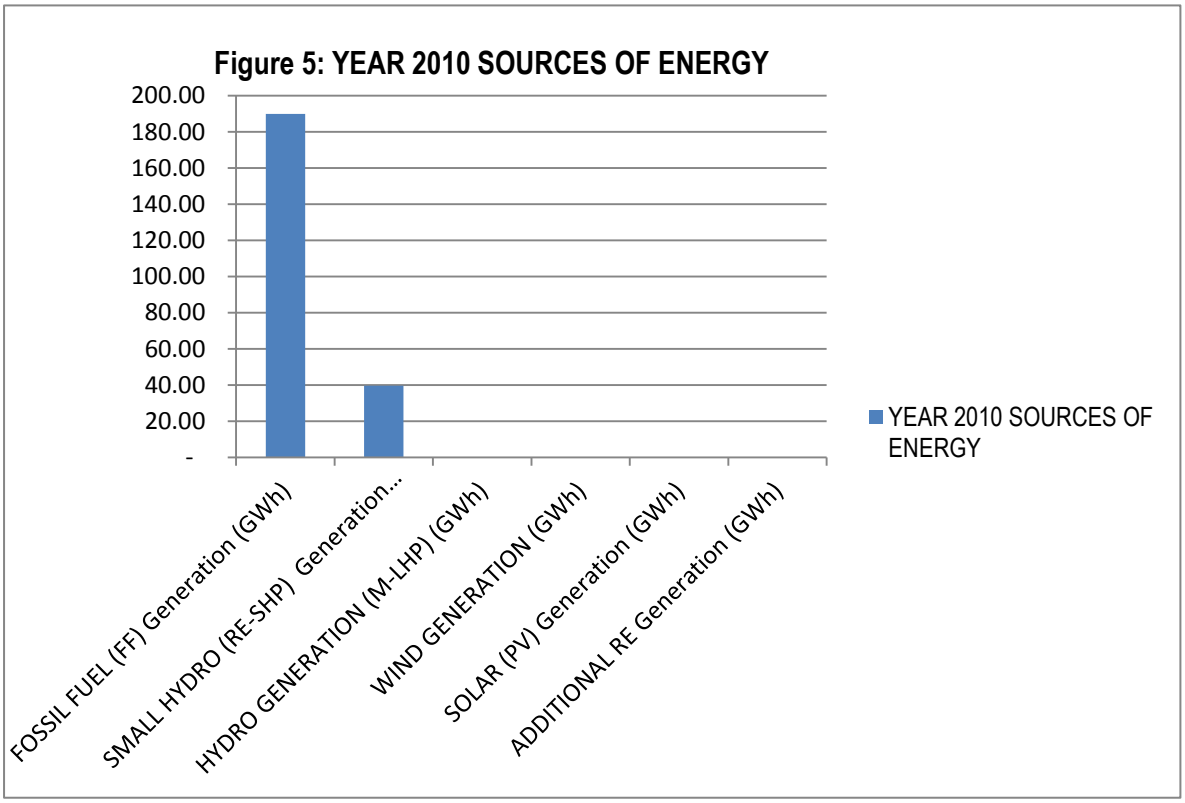
TABLE 15: VALUE OF ELECTRIC POWER GENERATION AND REQUIRED INVESTMENTS IN LD$ AND US$ FOR THE NREAP-EEAP-SE4ALL										
Developed on: 03.23.2015						VALUE IN Millions of US$				
YEAR	2010	2015	2020	2025	2030	2010	2015	2020	2025	2030
Baseline scenario ("Baseline") for the power sector										
Value of electricity generation (in Millions of Liberian Dollar)	8,208	18,057	39,725	87,393	192,261	103	226	497	1,092	2,403
Value of fossil fuel consumption (in Millions of Liberian Dollar)	3,250.5840	8,175.19	39,725	42,843	95,277	41	102	238	536	1,191
Rate of access to electricity	1.4%									
Scenario NREAP - NEEAP - SE4ALL										
Value of renewable electricity generation (in Millions of Liberian Dollar)	0	0	26,876	53,752	53,752	-	-	336	672	672
Value of savings (in Millions of Liberian Dollar)	0	0	10,176	31,855	69,339	-	-	127	398	867
Scenario with Efficiency + renewables (GWh)	0	0	858	1,982	2,849					
Value of EE + RE (in Millions of Liberian Dollar)	0	0	37,052	85,607	123,091	-	-	463	1,070	1,539
NPV of the set of action plans, in the starting year of implementation (in Millions of Liberian Dollar)	290,316									
Improvement in the national balance of payments = value of the reduction in fossil fuel consumption (in Millions of Liberian Dollar)	0	0	19,553	45,072	65,302	0	0	244	563	816
Rate of access to electricity	1.4%	1.4%	34.2%	67.1%	100.0%	144	328	1,442	3,261	5,949



9.0 ANNUAL POWER GENERATION RESOURCES MIX

The detailed breakdown of power generation from all sources is presented on table 16 below. Including additional power made available from RE, EE, loss reduction, sustainable energy measures total electricity available amounts to190GWh in 2010; 418GWh in 2015; 2,400GWh in 2020; 5,247GWh in 2025 and 8,542GWh in 2030. Figure 5 below presents the graphical picture of the various generation sources for the selected years. You will observe that for the year 2010, the predominant energy supply sources are predominantly from fossil fuels and relatively small amount from hydro. The contrast in Figure 6 below presents a range of other sources of electric power in the generation mix, namely hydro, solar PV, wind and biomass in addition to the small amount of fossil fuel which is eventually replaced by the RE sources.

TABLE 16: PROJECTED TOTAL GENERATION ALL SOURCES (GWh)					
Year	2010	2015	2020	2025	2030
Baseline (fossil fuel (FF)) Generation (GWh)	190.00	242.49	309.49	395.00	504.13
Baseline (RE-SHP) Generation (GWh)	39.51	39.51	39.51	39.51	39.51
Hydro Generation (M-LHP) (GWh)	-	-	1,950.00	3,900.00	3,900.00
Wind Generation (GWh)	-	-	0.16	0.31	0.31
Solar (PV) Generation (GWh)	-	-	225.00	450.00	450.00
Add RE Generation (GWh)	-	-	2,175.16	4,350.31	4,350.31
ENERGY EFFICIENCY GAINS					
Grid Loss Reduction (GWh)	-	-	30.95	71.10	90.74
domestic and public lighting (GWh)	-	-	116.00	251.16	412.73
building sector (GWh)	-	-	11.61	29.62	56.71
industry sector (GWh)	-	-	6.63	16.93	30.25
Total Savings	-	-	165.19	368.81	590.43



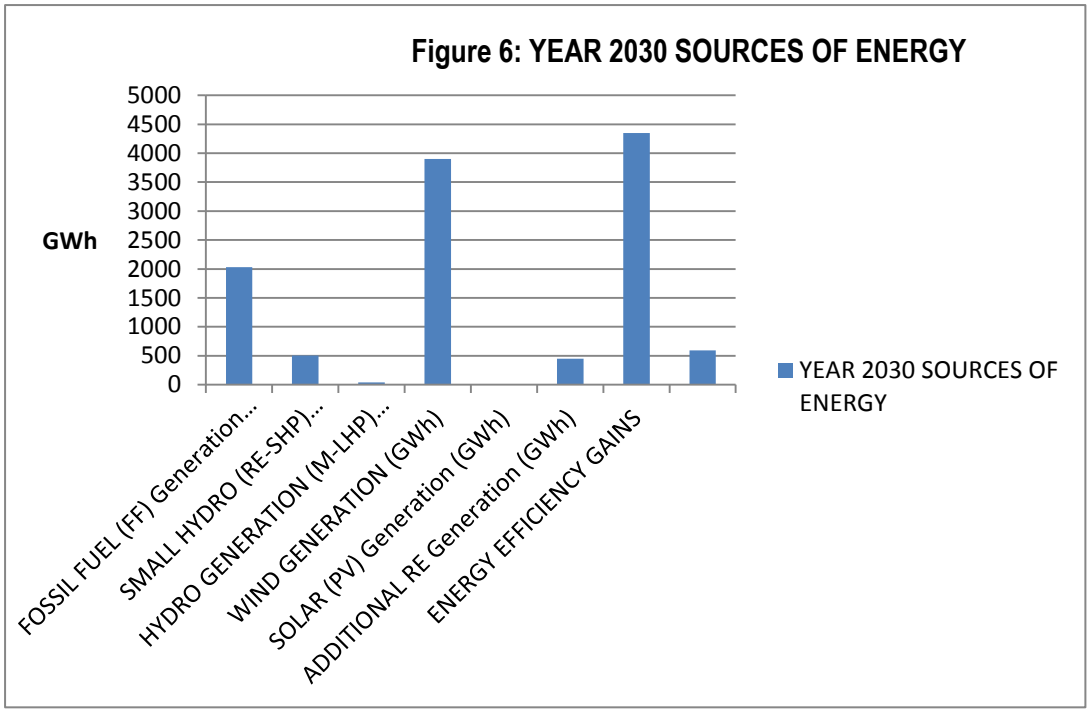


Figure 6: YEAR 2030 SOURCES OF ENERGY
GWh
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
FOSSIL FUEL (FF) Generation...
SMALL HYDRO (RE-SHP)...
HYDRO GENERATION (M-LHP)...
WIND GENERATION (GWh)
SOLAR (PV) Generation (GWh)
ADDITIONAL RE Generation (GWh)
ENERGY EFFICIENCY GAINS
YEAR 2030 SOURCES OF ENERGY

TABLE 17: ACCESS TARGETS FOR THE SHARE OF GRID-CONNECTED RENEWABLE ENERGY IN 2020 AND 2030					
In MW Installed Capacity	2,010	2,015	2,020	2,025	2,030
Other (FF) MW installed capacity	17.42	23.49	31.25	41.14	53.78
Small Scale Hydro energy installed capacity in MW (excluding medium and large hydro)	4.57	4.57	4.57	4.57	4.57
Small Scale hydro share of the total installed capacity in % (excluding medium and large hydro)	26%	19%	15%	11%	9%
Large- and medium scale hydropower capacity installed in MW (more than 30 MW)	-	-	225.69	451.39	451.39
Large- and medium scale hydropower (more than 30 MW) share of total installed capacity in %	0%	0%	5%	5%	5%
Other renewable energy capacity in MW (including large and medium scale hydro)	-	-	277.81	555.63	555.63
TOTAL RE CAMACITY in MW	4.57	4.57	508.08	1,011.59	1,011.59
Renewable energy share of the total installed Grid Connected capacity in % (including medium and large hydro)	21%	16%	94%	96%	95%
TOTAL INSTALLED CAPACITY in MW	21.99	28.07	539.33	1,052.73	1,065.36

10.0 THE ACCESS TARGETS FOR THE SHARE OF GRID-CONNECTED RENEWABLE ENERGY

10.1 GRID-CONNECTED RENEWABLE ENERGY

The access targets for the share of Grid-Connected Renewable Energy in 2010 to 2030 are presented in table 17 above. The RE share of total power generation is targeted to be 16% in 2015, and will be significantly increased to 94% in 2020, 96% in 2025 and 95% in 2030.

10.2 PROJECTED POWER GENERATION OR SAVINGS BY SOURCE

Table 21 below gives the annual power generation capacity in MW by source of generation for the years 2010 to 2030. The total generation capacity for 2010 is 22MW; for 2015 it increases to 28MW; for 2020 it is 539MW; for 2025, 1,053MW; and for 2030; 1,065MW.

Table 22 below presents the corresponding projected power generation in GWh which amounts for 2010 to 190GWh; for 2015 the generation is 243GWh; for 2020; 4,660GWh; for 2025; 9,096GWh; and for 2030; 9,205GWh.

TABLE 18: NATIONAL 2020 TO 2030 ANNUAL TARGETS AND ESTIMATED TRAJECTORY OF GRID CONNECTED CAPACITIES (MW)																					
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Small hydro (up to 30 MW)	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Medium and Large Hydro (more than30MW)	-	-	-	-	-	-	45.1	90.3	135.4	180.6	225.7	270.8	316.0	361.1	406.3	451.4	451.4	451.4	451.4	451.4	451.4
Solar	-	-	-	-	-	-	5.2	10.4	15.6	20.8	26.0	31.3	36.5	41.7	46.9	52.1	52.1	52.1	52.1	52.1	52.1
Tide, wave, ocean	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wind	-	-	-	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Additional RE (Bio-energy)	-	-	-	-	-	-	50.4	100.7	151.1	201.4	251.8	302.1	352.5	402.8	453.2	503.5	503.5	503.5	503.5	503.5	503.5
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total RE Generation Capacity (MW)	4.6	4.6	4.6	4.6	4.6	4.6	105.3	206.0	306.7	407.4	508.1	608.8	709.5	810.2	910.9	1,011.6	1,011.6	1,011.6	1,011.6	1,011.6	1,011.6
OTHER GENERATION (fossil fuel)	17.4	18.5	19.7	20.9	22.2	23.5	24.9	26.4	27.9	29.5	31.2	33.0	34.9	36.9	39.0	41.1	43.4	45.8	48.4	51.0	53.8
TOTAL Generation Capacity (MW)	**22.0**	**23.1**	**24.2**	**25.5**	**26.7**	**28.1**	**130.2**	**232.3**	**334.6**	**436.9**	**539.3**	**641.8**	**744.4**	**847.1**	**949.9**	**1,052.7**	**1,055.0**	**1,057.4**	**1,059.9**	**1,062.6**	**1,065.4**

TABLE 19: NATIONAL 2020 TO 2030 ANNUAL TARGETS AND ESTIMATED TRAJECTORY OF GRID CONNECTED RENEWABLE ENERGY GENERATION (GWh)																					
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Small hydro (up to 30 GWh)	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5
Medium and Large Hydro (more than30GWh)	-	-	-	-	-	-	390.0	780.0	1,170.0	1,560.0	1,950.0	2,340.0	2,730.0	3,120.0	3,510.0	3,900.0	3,900.0	3,900.0	3,900.0	3,900.0	3,900.0
Solar	-	-	-	-	-	-	45.0	90.0	135.0	180.0	225.0	270.0	315.0	360.0	405.0	450.0	450.0	450.0	450.0	450.0	450.0
Tide, wave, ocean	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wind	-	-	-	-	-	-	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Additional RE (Bioenergy)	-	-	-	-	-	-	435.0	870.1	1,305.1	1,740.1	2,175.2	2,610.2	3,045.2	3,480.3	3,915.3	4,350.3	4,350.3	4,350.3	4,350.3	4,350.3	4,350.3
Geothermal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total RE Generation (GWh)	39.5	39.5	39.5	39.5	39.5	39.5	909.6	1,779.6	2,649.7	3,519.8	4,389.8	5,259.9	6,129.9	7,000.0	7,870.1	8,740.1	8,740.1	8,740.1	8,740.1	8,740.1	8,740.1
OTHER GENERATION (Baseline)	150.5	160.0	170.0	180.4	191.4	203.0	215.1	227.8	241.2	255.2	270.0	285.5	301.7	318.8	336.7	355.5	375.2	396.0	417.7	440.6	464.6
Total Generation RE Case (GWh)	190.0	199.5	209.5	219.9	230.9	242.5	1,124.7	2,007.5	2,890.9	3,775.0	4,659.8	5,545.3	6,431.7	7,318.8	8,206.7	9,095.6	9,115.4	9,136.1	9,157.9	9,180.7	9,204.8

10.3 OFF-GRID RENEWABLE ENERGY ACCESS TARGETS

The required electrification for 2010 to 2030 in general as well as for the envisaged contribution of renewable energy based stand-alone systems and mini-grids were determined and appropriate targets set. These national targets will contribute to the achievement of the regional rural renewable energy electrification targets in the EREP. In addition to the targets, the corresponding appropriate trajectory was computed taking into consideration the expected growth of the population with access to electricity and the likely social-economic development of the planning years 2010, 2015, 2020, 2025 and 2030. Table 20 below presents the contribution of renewable energy to electricity access targets expressed as a percent of increase in the population access to electricity. The access is expected to increase from 1.4% of the population having access in 2010 and 2015 to 34.2% in 2020; 67.1% in 2025 and 100% in 2030.

10.3.1 Access to Electricity Baseline Scenario

TABLE 20: ACCESS TO ELECTRICITY

Year	2010	2015	2020	2025	2030
Baseline scenario ("Baseline") for access to electricity					
Total number of households (thousands)	712	786	868	958	1,058
Number of electrified households, based on current rate of access (thousands)	10	11	12	13	14
Fossil fuel consumption (000 kg)	21,065	23,257	25,678	28,351	31,301
Value of fossil fuel consumption (in Millions of Liberian Dollars)	2,528	2,791	3,081	3,402	3,756
Scenario with measures to achieve universal access					
Annual increase in the rate of access to electricity, scenario "Access"	6.6%				
Increase in the rate of access	0.0%	0.0%	6.6%	6.6%	6.6%
Rate of access	1.4%	1.4%	34.2%	67.1%	100.0%
No. of electrified households, scenario "Access" (000)	10	11	297	643	1,058
No. of remaining households without access to electricity (000)	702	775	571	315	-
No. of new connections to the grid (thousands)	-	-	34	38	12
Investment for grid connections (in Millions of Liberian Dollars)	-	-	822	907	299
New off-grid services (thousands)	-	-	23	25	8
Investment for off-grid services (in Millions of Liberian Dollars)	-	-	548	605	199
Scenario with measures for off-grid lighting					
No. of off-grid electric lighting devices distributed/sold according to the "access plan" (thousands)	-	-	68	76	25
Total number of off-grid electric lighting devices in use (thousands)	-	-	329	693	1,035
No. of replacements of used lighting devices (thousands)	-	-	110	231	345
Value of lighting devices distributed/sold, 'access plan' + replacement (000 000 Liberian Dollar)	-	-	285	490	592
Reduction of fossil fuel consumption (thousands kg)	-	-	8,559	18,900	31,301
Value of the reduction in fossil fuel consumption (in Millions of Liberian Dollars)	-	-	1,027	2,268	3,756
Economic balance of the set of measures for access to electricity					
GDP increase attributable to sheet 'Access' (in Millions					

TABLE 20: ACCESS TO ELECTRICITY					
Year	2010	2015	2020	2025	2030
Baseline scenario ("Baseline") for access to electricity					
of Liberian Dollars)	-	-	1,369	3,024	5,008
Annual investment = Invest. grid + Invest. Off-grid + Invest lighting devices (in Millions of Liberian Dollars)	-	-	1,655	2,002	1,090
Cash flows = GDP increase + reduced fossil fuel cons - investment (in Millions of Liberian Dollars)	-	-	742	3,290	7,675
NPV (Net Present Value) (in Millions of Liberian Dollars)					
Total investment (in Millions of Liberian Dollars)	26,580				

10.3.2 Contribution of Renewable Energy to Electricity Access Targets

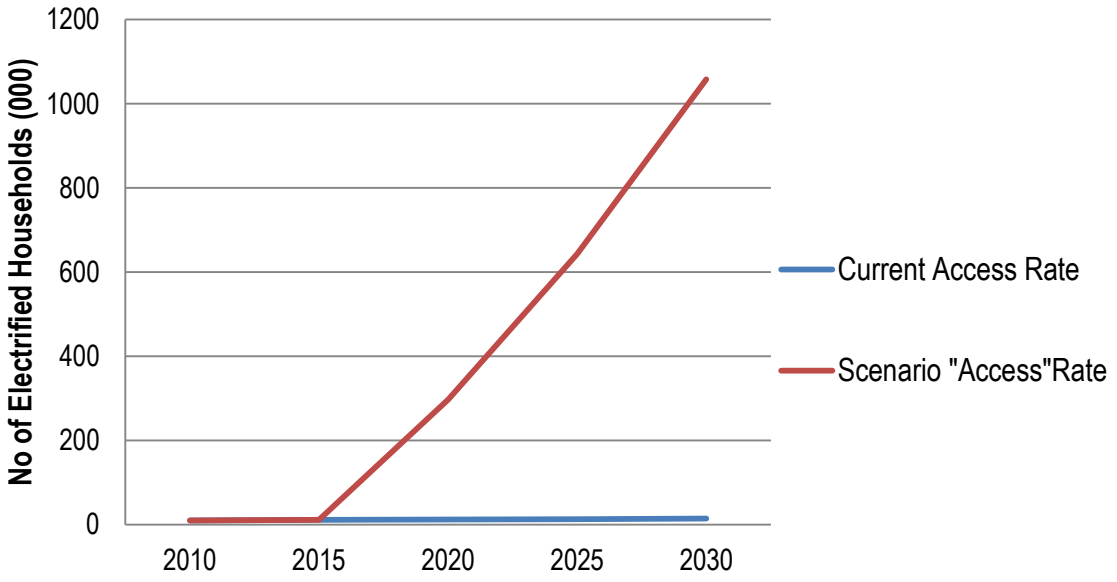
The contribution of RE to electricity access is targeted to average 30% of the access from Grid Connected population; seven percent (7%) from rural population annually supplied from Renewable energy and hybrid Mini-Grids and about four percent (4%) on the average, rural population served by standalone renewable energy systems. Projected targets for the number of Hybrid Mini-Grids is 23 for 2020; 25 for 2025 and 30 for 2030. See Table 21 below.

TABLE 21: CONTRIBUTION OF RENEWABLE ENERGY TO ELECTRICITY ACCESS TARGETS					
	2010	2015	2020	2025	2030
Share of Population Served by Electricity Services (%)	1.4%	1.4%	34.2%	67.1%	100.0%
Share of Population Connected to the Grid (%)	1.4%	1.4%	26.7%	51.0%	67.0%
Share of Population Served by Renewable Energy and Hybrid Mini-Grids (%)	0.0%	0.0%	4.9%	11.0%	19.6%
Share of Population Served by Standalone Renewable Energy Systems (%)	0.0%	0.0%	2.6%	5.1%	13.4%
Number of Re/Hybrid Mini-Grids	-	-	23	25	30

A comparison of the number of households with access to electricity connection for the baseline scenario in comparison to the access interventions scenario is shown in figure 7 below. It is clearly evident that the access scenario is far greater than the baseline. See Figure7 below: Access is expected to average 12,000 households per year for the Baseline, while as it averages to 404,000 connections per year reaching to over a million connections by 2030 for the RE-EE-SE Scenario.

Table 22: Scenario Comparison					
Year	2010	2015	2020	2025	2030
Number of electrified households, based on current rate of access (000)	10	11	12	13	14
No. of electrified households, scenario "Access" (000)	10	11	297	643	1,058

Figure 7: Current Access Rate Vs RE-EE-SE Scenario Access Rate



10.3.3 Targets and Estimated Trajectory for Rural Population Served by RE

The Rural Population numbers targeted trajectory for electricity services ranges from virtually 0% of the population in 2015 served in the rural areas to 16% served with grid connected electricity services by 2020, to 24% served by 2025 and at least 38% served by 2030.The remaining population will be served by RE and hybrid mini-grids amounting to 20%, 25% and 35% respectively for 2020, 2025 and 2030. The remainder will be served by standalone systems to achieve the universal access targets for cooking and lighting through the use of the various access measures presented in the further chapters of this document. See table 23 below.

TABLE 23: NATIONAL 2010 to 2030 TARGETS AND ESTIMATED TRAJECTORY FOR RURAL POPULATION SERVED BY RE

	2010	2015	2020	2025	2030
Total Rural Population (number of inhabitants 000)	2,468.0	2,685.0	2,876.0	3,078.0	3,290.0
Rural population served with grid connected electricity services (number of inhabitants 000)	0.0	0.0	460.0	739.0	1,255.0
Rural population served with grid connected electricity services (% of total)	0.0%	0.0%	16.0%	24.0%	38.1%
Rural population served with Mini-grid renewable electricity services (RE only and hybrid) (number of inhabitants)	0.0	0.0	576.0	770.0	1,152.0
Rural population served with mini-grid renewable electricity services (RE only and hybrid) (%)	0.0%	0.0%	20.0%	25.0%	35.0%
Remaining Rural Population served by Other Stand alone and off-grid services	2,468.0	2,685.0	1,840.0	1,569.0	883.0
Remaining Rural Population served by Other Stand alone and off-grid services %	100.0%	100.0%	64.0%	51.0%	26.8%
** The most recent year for which statistics are available*	100.0%	100.0%	100.0%	100.0%	100.0%

The breakdown of the targets trajectory between the installed capacities of Mini-grids/Off-grid (RE and Hybrid); PV, pico-hydro and small-scale wind systems and the other grid power capacities in MW is presented on table 24 below. The power generation capacity is projected for Mini-grids (RE and Hybrid) to contribute 47% of capacity by 2020, 45% of total by 2025 and 29% of total by 2030. For the PV, pico-hydro and small-scale wind systems, its share of generation capacity is projected to be 23% of total generation capacity in 2010, 10% in 2015, 13% in 2020, 11% in 2025 and 7% in 2030. This drop in the percentage is proportional to the increase in the contribution of the more desirable sources of grid and mini grid larger quantities of power.

10.3.4 Targets and Estimated Trajectory for Off-Grid RE Systems

The bulk of the power generation will come from grid generation capacity whose percentage share of total capacity decreases over the years as the mini-grid sources become more and more developed and desirable. The respective grid capacity targets are 33MW for 2020 and 61MW each for 2025 and 2030 respectively. See the respective capacities in MW in table 24 below.

TABLE 24: NATIONAL 2020 AND 2030 TARGETS AND ESTIMATED TRAJECTORY FOR OFF-GRID RE SYSTEMS

YEAR	2010	2015	2020	2025	2030
Off-grids/Mini-grids (RE and Hybrid) (in MW of installed capacity)	-	-	6.57	8.57	8.57
PV, pico-hydro and small scale wind systems (MW)	-	0.06	26.06	52.12	52.12
Sub-Total Off-grid/Mini-grids RE installed capacity (MW)	**-**	**0.06**	**32.63**	**60.69**	**60.69**

11.0 RENEWABLE ENERGY APPLICATIONS FOR DOMESTIC USES

11.1 DOMESTIC COOKING ENERGY TARGETS AND TRAJECTORIES

TABLE 25: MODERN COOKING					
Baseline scenario ("Baseline") for cooking					
Year	2010	2015	2020	2025	2030
Total number of households (thousands of households)	712	786	868	958	1,058
No. of households using LPG (thousands of households)	71	79	87	96	106
No. of households using an improved cookstove (thousands of households)	107	118	130	144	159
No. of households using an alternative technology (thousands of households)	7	8	9	10	11
Total: families using modern cooking devices, baseline scenario (thousands of households)	185	204	226	249	275
Scenario with measures to achieve universal access to modern cooking, "Cooking Plan"					
No. of households using LPG (thousands of households)	71	79	182	305	453
No. of households using an improved cookstove (thousands of households)	107	118	225	353	506
No. of households using an alternative technology (thousands of households)	7	8	20	34	50
Total: families using modern cooking devices, baseline scenario (thousands of households)	185	204	426	692	1,009
Annual investment LPG (in Millions of Liberian Dollars)	-	0.94	4.03	5.71	7.68
Annual investment improved cookstove (in Millions of Liberian Dollars)	-	0.14	0.46	0.63	0.83
Annual investment alternative technology (in Millions of Liberian Dollars)	-	0.09	0.45	0.64	0.86
Total investment (in Millions of Liberian Dollars)	99.33				

In this section, the required national targets are presented regarding renewable energy applications for domestic uses as well as its trajectory to 2010 to 2030 is analyzed for the baseline and the access measures scenarios. For the Baseline scenario, the share of population using improved cook-stoves will rise at a constant rate of 26% in 2010, 2015, 2020, 2025 and 2030 each. For the baseline case, the share of population using modern fuel alternatives for cooking (e.g. LPG, biogas, solar cookers, kerosene) will increase at a constant rate of 10% of the population for each of the selected years.

When the access measures are introduced, the share or population changes to 26% for 2010 and 2015 each and goes up to 49% in 2020,; 72% in 2025 and 95% in 2030. Charcoal production for domestic uses produced using efficient technologies will rise from 1% in 2010 to 15% of the charcoal production in 2020 and 58% in 2030.

The share of population using modern fuel alternatives for cooking (e.g. LPG, biogas, solar cookers, kerosene) will increase at rate of 10% of the population for each of the years 2010 and 2015, but quickly takes off to 20%, 332% and 43% for the years 2020, 2025, and 2030 respectively. See table 26 below. Required annual investments to achieve these targets are estimated to range from US$10,000 in 2015, US$60,000 in 2020, US$90,000 in 2025 and us$120,000 in 2030.

TABLE 26: DOMESTIC COOKING ENERGY TARGETS FOR 2020 AND 2030					
YEAR	2010	2015	2020	2025	2030
Share of Population Using Improved Cook-Stoves in %	15%	15%	15%	15%	15%
Share of households using an alternative technology (%)	1%	1%	1%	1%	1%
Share of households using LPG (%)	10%	10%	10%	10%	10%
Total families using modern cooking devices (%)	26%	26%	26%	26%	26%
Measures to Universal Access to Modern Cooking, "Cooking Plan Scenario"					
Share of Population Using Improved Cook-Stoves in %	15%	15%	26%	37%	48%
Share of households using an alternative technology (%)	1%	1%	2%	4%	5%
Share of households using LPG (%)	10%	10%	21%	32%	43%
Total families using modern cooking devices (%)	26%	26%	49%	72%	95%
TOTAL ANNUAL INVESTMENTS (Millions of Liberian Dollars)	-	1.17	4.93	6.97	9.38
In Millions of US$	-	0.01	0.06	0.09	0.12

11.2 SOLAR THERMAL WATER HEATING

The required targets regarding the use of solar water heating technologies for domestic uses in 2020 and 2030 are presented in table 27 below. These figures are derived from calculated results of the scenario tool.

TABLE 27: SOLAR THERMAL WATER HEATING TARGETS FOR 2020 AND 2030			
Solar water heaters for sanitary hot water and preheating of industrial process hot water:	2010	2020	2030
No. of residential houses with solar thermal systems (000)	0	17.4	52.9
Share of district health centers, maternities, school kitchens and boarding schools with solar thermal system in %	0	5	10
Share of agro-food industries (preheating of process water) with solar thermal systems in %	0	5	15
Share of hotels with solar thermal systems in %	1	10	15

The projected number of buildings with solar thermal systems will amount to negligible quantity in 2010 and are projected to rise progressively to 86,000 in 2020, and up to 120,000 in 2030. District health centres, maternity clinics, school kitchens and boarding schools did not use solar thermal systems in 2010, but the percentage share of institutions using solar thermal systems will rise to 5% in 2020 and 10% in 2030.

11.3 BIO-FUELS TARGETS

This section presents the required targets and projected bio-fuel in the fuel usage by 2010, 2020 and 2030 respectively rising from 0% share in 2010 up to 2% by 2020 and 5% by 2030. Table 28 below presents the targets for years 2010 to 2030 projection of Ethanol as share of gasoline consumption (%) and Biodiesel as share of Diesel and Fuel-oil consumption (%) share of biodiesel in the fuel-oil mix based on bio-fuel use as fuel (in the form of biodiesel and ethanol) targets in accordance with the target set in the 2009 NEPL. (Reference to the ECOWAS Targets for Domestic Applications and Bio-fuels; see also Liberia SE4All; also ECOWAS Renewable Energy Policy Mandated Member States Targets; and Assessment of Biomass Resources in Liberia by NREL)

TABLE 28: BIO-FUELS TARGETS FOR 2020 AND 2030			
Bio-fuels Targets (1st generation)*	2010	2020	2030
Ethanol as share of gasoline consumption (%)	0	2	5
Biodiesel as share of Diesel and Fuel-oil consumption (%)	0	2	5
*Source: 2009 NEPL			

12.0 POWER SECTOR MARKET DEVELOPMENT INDICATORS

12.1 STATUS OF RENEWABLE ENERGY INVESTMENT IN THE COUNTRY

This section presents available information and reported current status of investments in renewable energy in the Liberian market and where available, the share of which are locally produced. Table 29 below is intended to serve as the benchmark by which to measure progress in local renewable energy market development by the years 2020 and 2030. Available information and estimates show that total investments in newly installed RE electric capacity, excluding medium and large hydroelectric capacity is around US$ 3.35 million (mainly small scale hydro less than 30 MW and solar energy. Investments in large scale hydro (Mt. Coffee hydro) power amounted to US$383 million. See Table 29 below.

TABLE 29: STATUS OF RENEWABLE ENERGY INVESTMENT IN THE COUNTRY			
		2010	2013* (US$)
Total investment in newly installed RE electric capacity (in US$) - excluding medium and large hydro	Small hydro (up to 30 MW)		500 thousand
	Solar		2.2 million
	Tide, wave, ocean		0
	Wind		0
	Bioenergy		650 thousand
Total investment in newly installed RE electric capacity (in US$$) - incl. medium and large hydro			383 million
Total investment in solar thermal			300 thousand
Total investment in other RE sectors (non-electricity e.g. bio-fuels)			250 thousand
Volume of contracts for local manufactures/assembly industry's/local installers of total investments (in Euro)	Small hydro (up to 30 MW)		
	Solar		200 thousand
	Tide, wave, ocean		0
	Wind		0
	Bioenergy		150 thousand
	Solar thermal		0
Number of registered companies, NGOs and Firms in the RE field (number of companies)			16
Total investment in newly installed RE capacity (in US$) - excluding medium and large hydro, with the participation of local commercial banks	Small hydro (up to 30 MW)		0
	Solar		500 thousand
	Tide, wave, ocean		0
	Wind		0
	Bioenergy		0
	Solar thermal		0
Number of commercial banks financing RE in the region (number of banks)			0
Estimates for the most recent year for which information was gathered			

12.2 CURRENT KNOWN ENERGY RELATED REGISTERED LIBERIAN OWNED COMPANIES

TABLE 30: CURRENT KNOWN ENERGY RELATED REGISTERED LIBERIAN OWNED COMPANIES

NO.	ORGANIZATION	ACTIVITY
1	Fosera Liberia	Small solar energy
2	Sorlumba Comm. Electric Cooperative	Renewable energy business (mini hydro project)
3	Gbanway Woeyah Electric Cooperatives	Agriculture and Renewable Energy -distribution of stand along solar panel for every house
4	Liberian Energy Network	Selling and distributing solar panel lights
5	Community Power House	Distribution and sale of electricity
6	Diggs Light	Sale of solar lights
7	Eagle Electric Power	Power production, transmission & distribution
8	African Green Energy Systems	Importation, distribution, training and installation of renewable energy modules
9	Ecopower Liberia	Power generation utilizing biomass
10	Solar Solution Liberia INC	Sale of solar panels
11	SJedi Green Energy	Sale of energy char coal stoves
12	Mein River Company	Energy, hydro
13	Geontia	Energy, generation & Distribution
14	MEPEC Group, Inc.	Energy & Environment

Registered Liberian Energy Companies

It is planned that the GOL will target a number of Registered Liberian Energy Companies will be encouraged to be active in the Liberian energy sector. The projected number of such registered companies to be targeted for GOL support and encouragement schemes is estimated to be 6 in 2010, about 14 in 2015, 16 in 2020; 20 in 2025 and 34 in 2030. See table 31 below.

TABLE 31 NATIONAL 2020 AND 2030 TARGETS AND ESTIMATED TRAJECTORY OF REGISTERED LIBERIAN ENERGY COMPANIES

	2010	2015	2020	2025	2030
Number of registered companies or firms in the RE field	6	14	16	20	34

** The most recent year for which estimates are made*

13.0 MEASURES FOR ACHIEVING THE TARGETS

The following chapter presents Liberia's measures and activities intended to achieve the set targets in the previous chapter. The implementation of the activities will be monitored by the planned coordination and monitoring structures and system as well as by ECREEE on the regional levels.

The following section summarizes the policies and measures existing or planned by the GOL aimed at the set targets and policy goals of the government to develop and promote the use of renewable energy resources, energy access and energy efficiency. They are grouped into the categories of Policies and Measures for:

- Grid-Connected RE;
- Off-Grid RE;
- Domestic Cooking Energy;
- Solar Water Heating; and
- Bio-fuels.

The **tables A – E** in **Appendix I** of this document then present a more detailed **overview of the specific planned policies and measures** by type of measure, expected results and the target group and estimated timeframe for implementation of the respective measures. The respective measures can be collectively described as follows:

TYPE OF MEASURE*

1. Regulatory, Policy, Enabling Environment, Administrative Procedure
2. Financial,
3. Capacity Building, Soft (i.e. information campaign),
4. Efficiency Improvement, Technology Equipment, Bio-fuel Technology, Solar technology, Baseline Data, etc.

EXPECTED RESULTS**

1. Behavioural Change, Transformation, Connection Access,
2. Installed Capacity (MW; t/year), Loss Reduction, Modern Cooking, Public Awareness, Behavioural Change, Employment, Economic Empowerment
3. Energy Generated (MWh/year), Improved Management, Technical capacity, Increased Investment, Local Participation

TARGET GROUP AND/OR ACTIVITY***

1. Investors, Local Community Involvement, Local Content
2. End Users, Customers Benefits, Increased Connections, Access Targets Achieved
3. Public Administration, Education, Health, Employment
4. Planners, Technicians, Labour Improvement
5. Architects, Designers, Engineers, Energy & Power Specialists, Consultants
6. Installers, Workers, Entrepreneurs, Developers, Community Sensitizers, Civil Society
7. Urban or Rural Population, Village Level Units, Power Producers, Mini-grids, Off-grids, Stand-alone Units
8. Health Centres, Schools, Community Colleges, Local Institutions, Public Buildings, etc.
9. Targeted Activity / Sector: (Bio-fuel Production, Solar PV Facility, Energetic Use of Animal Manure, etc.),
12. Local Community Land Use Improvements,
13. Energy Farms, Fast-growing Firewood Lots,

EXISTING OR PLANNED

1. Planned
2. Existing.

START AND END DATE

1. Dates, Duration,
2. Process Required,
3. Start Process
4. End Requirement

SEE APPENDIX I.

13.1 SPECIFIC MEASURES FOR REQUIREMENTS UNDER THE EREP

13.1.1 Administrative Procedures and Spatial Planning

Examining the current process of authorization, certification and licensing of power transactions with producers, power plants and associated transmission and distribution network for electricity production, Liberia currently applies a number of legislative instruments, policies, and consults with, involves or refers to specific institutional as well as administrative responsible entities. Prospective or potential investments have been categorized into three (3) procedures or pathways to approving investments in Liberia. These include but are not limited to the following processes:

1. **Standard Business** which requires no incentives – These go through the Liberia Business Registry (LBR) a semi-autonomous government agency, which operates as a one-stop-shop to formalize or register all enterprises and provide information services to the public.

2.. **Special Investment Incentives through the Liberia National Investment Commission apply for businesses that are typically less than US$ 10 Million and seek government incentives.**
The National Investment Commission (NIC) has the mandate for registration of large investments; typically, a foreign owned investment is advised to contact the NIC as the first point of contact for this category of investments.

3. **Concessions are businesses that invest over US$ 10 Million and seek extra considerations from the government**. These will typically commence the transaction process through the "line agency" (e.g. MLME for Power Sector, mineral, etc.)

In addition to business registration with the Liberia Business Registry and filing of articles of incorporation for the business entity, the NIC may trigger sector specific licenses and permit requirements. Depending on the size and type of business, applicable laws and legal regulations include but are not limited to the following list of regional legislations concerning authorisation, certification, licensing procedures and spatial planning, which are applied to power plants and associated transmission and distribution network infrastructure:

- The Consolidated Tax Amendment Act of 2010 – Ministry of Finance and Development Planning (MFDP)
- The Liberia Environmental and Management Law – Environmental Protection Agency (EPA)
- The 2015 Electricity Law of Liberia – Ministry of Lands, Mines & Energy (MLME), and DOE/LERC
- The Land Rights Policy which concerns four land rights categories (Public Land, Government Land, Customary Land, and Private Land), and a cross-cutting sub-category called Protected Areas, which must be conserved for the benefit of all Liberians - Land Commission of Liberia (LCL)
- Revenue Code of Liberia 2000 and amendments there after – Liberia Revenue Authority (LRA)
- Labour Law of Liberia – Ministry of Labour
- Liberia Agriculture Sector Investment Program – Ministry of Agriculture (MOA)
- National Legislature- Investments in the category of concessions are required to be ratified by the National Legislature after all negotiations for the concession right have been concluded
- The Zoning Cod of Liberia – Ministry of Public Works

Where further steps are needed to ensure that procedures are proportionate and necessary, the GOL shall undertake measures to revise the above listed registration, certification and licensing process to make it a straight forward process including strengthening the administrative and licensing process in general including a "one-stop-shop" for electric power transactions (generation, transmission, distribution, sales, import & export, duties, taxies, equipment, technologies, software, and related operations).

With the above listed legislations, it is clear that there is need for revising the business registration and certification process tailored specifically for the electricity sector of Liberia. It is therefore planned that comprehensive information on the authorisation, certification and licensing processes and on assistance to applicants will be made available. Moreover, the RREA shall develop specific information and assistance packages available to potential applicants for new renewable energy installations in the near future.

Specific incentives for small-scale, decentralised off-grid installations (such as PVs or pico-hydro) shall be developed by the MLME and RREA including grants and micro-credits from the Renewable Energy Fund.

13.2 COORDINATION IN THE AUTHORIZATION AND LICENSING ACTIVITIES

In the process of granting of authorization, certification, and licensing of IPPs, investors, developers and entrepreneurs for power sector transactions and operations of various types (grids, mini-grids, off-grids, stand-alone, etc.), as well as for granting of environmental permits, construction permits, social-economic agreements, etc. the GOL shall ensure, that there will be organized and structured coordination/cooperation between the different actors involved in the authorization, certification and licensing activities by creating a one-stop-shop for the permission process. Horizontal coordination shall be facilitated between different administrative bodies and government agencies responsible for the different parts of power generation permission to ensure a reasonably fast transaction process void of barriers and unnecessary costs and wrong/uninformed decisions.

13.3 Technical Specifications for Buildings

To benefit from support schemes, renewable energy technologies will need to meet certain quality standards as follows:

Buildings presently account for a large percentage of electricity consumption and very little consideration is taken to ensure energy use efficiency.

There are limited actions, programs or campaigns being implemented in Liberia for the demand side management and energy efficiency in buildings. It is therefore planned for LEC and other power producers to implement demand side management tools in order to optimize the use of electric energy. This is also valid for smoothing out demand peaks and for reducing pressure for additional capacity. Technical support and funding can be provided by donors for such programs.

It is projected that the use of electricity from renewable energy sources in buildings will increase by 3 – 5 percent annually until 2030 (differentiated between residential, commercial, public and industrial.), but the introduction of energy efficiency measures for buildings will bring savings in total energy demand for buildings of 9 to 28% per year by 2030.

The existing national and regional legislations including the zoning code from the Ministry of Public Works shall be strengthened to specify the required increase in the share of energy from renewable sources in the building sector in compliance with internationally acceptable standards of the industry.

Table 32 below gives a projected increase of renewable energy use in buildings until 2030 differentiating between residential, commercial, public and industrial electricity demand.

TABLE 32: INCREASE OF RENEWABLE ENERGY USE IN BUILDINGS UNTIL 2030 (GWh)				
	2010	2015	2020	2025
Residential	8	9	34	44
Commercial	9	10	39	51
Public	5	6	23	30
Industrial	3	4	15	20
Total	**25**	**28**	**112**	**145**
% Share of total generation	0%	1%	5%	3%
Savings with EE	0%	0%	9%	28%

The GOL will support the implementation of capacity building/ training programs on energy auditing and management activities alongside other programs and initiatives in the region.

It is planned for the GOL through the relevant agency such as the Ministry of Public Works to revise existing official guidelines for local and administrative General Service Agencies (GSA) on planning and designing, buildings and refurbishing industrial and city corporation's projects to make provision for installing equipment and systems that use RE in electricity and water heating.

13.3.1 Information Provisions and Capacity Building

Information and awareness raising campaigns and programmes, as well as planned revisions of at least once every five (5) years will be undertaken with the expectation that every community will be aware of energy management, conservation and efficiency measures and requirements in all sectors. The DOE/MLME shall be the responsible authority for information provision on RE, EE and EA and shall be monitored by the NERC to evaluate the impacts and make appropriate revision of the information program to achieve the targets. The Ministry of Information, NERC and the RREA shall also have important roles to play in the information provision program. Policy regulations shall be promulgated towards the provision of information on RE, EE and AA. The DOE shall set up public information sessions for the general public and provide information to target groups about support available and measures for raising public awareness and acceptance. Identify and promote funding assistance programs for the public to undertake RE, EE and AA projects.

Develop and implement sustainable renewable energy market promotion programmes and encourage research development in renewable energy.

The DOE shall undertake information, advocacy and awareness raising measures for RE project for developers and the general public to understand the nexus between renewable energy and energy efficiency and energy access.

The DOE shall be responsible to publish and make adequate information available on supporting measures for using renewable energy sources in electricity as well as the net benefits, costs and systems using RE in rural areas to all relevant actors (consumers, builders, installers, architects, rural developers, financial institutions and suppliers of relevant equipment, including NGO's, public administration and civil society) as well as the role of men and women, regional and local actors in designing and managing the information program.

There is currently a lack of local new skills and human resources in the energy sector. Further to several years of conflicts, the stock of Liberian technicians and engineers trained or graduated in the energy/electricity sector have drastically decreased. Measures and strategies must be put in place by responsible authorities (education) for preparing the replacement of staff who will retire soon from LEC or MLME. Investments in human capital development for the power sector should be taken to be amongst top priorities. Liberian universities and technical institutes shall design appropriate academic programs and strengthen the University of Liberia in the sector of electrical engineering. Exchange with foreign universities and scholarships for students shall be the immediate good alternative together with training through staff exchange programs with foreign electric utilities.

Considering that appropriation and ownership of skills and capacities by nationals are low, and technical assistance programs, consultancy services contracts (technical and design studies) do not emphasize enough the aspect of skills transfer. The GOL shall introduce appropriate clauses in funding agreements, technical assistance programs and consultancy service contracts imposing contractors' commitments and obligations to transfer skills and knowledge to local personnel. To implement this measure, the GOL shall require that outputs and outcomes must be measurable through agreed indicators and remuneration shall be performance based.

Appropriate institutional capacities shall be built including empowerment of entrepreneurs and communities' responsible bodies such as local cooperatives for electricity, local electricity sales agents, etc. and expected access and efficiencies results shall be targeted and pursued.

13.3.2 Certification of Installers for RE Equipment

With reference to the existing national legislations concerning certification or equivalent qualification schemes and standards for installers of RE equipment mentioned in section 9.2.1 above, the National Electricity Regulatory Commission or its equivalent at DOE/MLME shall give appropriate licenses, certification and permits for installers of small-scale biomass boilers and stoves, solar photovoltaic and solar thermal systems in accordance with the above corresponding tabulated targets on a yearly basis including the licensing of mini-grid and stand alone BTG systems providers. Information on these certification and licensing schemes shall be made public for competitive and transparent process.

Transparency in managing concessions awards, tariffs computations and operator remuneration must be translated into the regulatory framework and in the text of applicable laws. Delegating generation to the private sector under appropriate rules and monitoring systems is one of these measures.

14.0 ELECTRICITY INFRASTRUCTURE DEVELOPMENT

Based on the current situation and already existing legislation and targets, projects on electricity infrastructure development shall be undertaken through the relevant actors, including private sector independent power producers (IPPs), public corporations, NGOs, Mining, Agriculture and other Concessioners, Donor Partners, etc., in accordance with the NREAP-NEEAP-SE4All AA and the RREA released Rural Electrification Master Plan approved by the GOL. These action plans and targets shall be appropriately updated and revised periodically. The plans for the Cross Border Project and the CLSG ECOWAS WAPP Transmission Line project will be vigorously pursued, and provisions within the CLSG ECOWAS Treaty and its respective agreements and plans shall be undertaken and the respective legislations on cross border electricity trade will be implemented. Targets and capacities for interconnection and appropriate standards with neighbouring countries shall be planned and implemented accordingly.

In this process of infrastructure development, all RE mini-grids, off-grids and other power production operations in the proximity of the CLSG transmission lines shall be required to comply with the standards that ensure integrating the targeted amount of renewable electricity sources and insuring security of the system. There shall be expedited approval and licensing process for all interconnections to the CLSG lines from mini-grids and off-grids, and other power production operations that meet the standards.

Coordination between grid and BTG infrastructure and other administrative planning procedures shall be regulated and the approval process regulated and expedited by the NERC, which includes providing the necessary information on costs, the precise timetable for processing their requests for approval and an indicative timetable for their grid connection. The priority connection and transmission rights and capacities shall be given to new installations producing electricity from renewable energy sources, with appropriate cost sharing, tariffs and wheeling agreements put in place.

14.1 REGULATION FOR GRID CONNECTED RE

Mitigate high costs: In Liberia, the present average household tariff (for the Monrovia LEC grid) is US$0.52/kWh. The informal Independent Power Producers (IPPs)" operating in Liberia report that the cost of

operating small individual diesel/gasoline generators is much higher and their tariffs are even higher than the LEC tariff. It is therefore planned to mitigate the high cost and develop a more reasonable tariff structure for both the LEC and for IPPs.

The national grids expansion program and the access plan forecasts and trajectories must be executed in such a way as to meet the ECOWAS energy policies. The grids will be assessed and problems resolved to ensure that those circuits to be developed and the grid expansions are adequate to carry their expected loads under various operational conditions, and ensure that voltage drop and technical losses are within acceptable limits. A rigorous technical design involving load flows, short circuit analysis, and reliability investigations shall be required and would have to confirm the adequacy of the expansion program. Studies and development/master plans that donors intend to support should cover this aspect.

Coherence between the grid expansion program and the access plan forecasts of the NREAP-NEEAP-SE4All is to be strengthened. The LEC capacities are insufficient to install connections required by the targets of the access plan announced by the Government and embedded in the NREAP-NEEAP-SE4All set of goals. Keeping the rates of new connections at approximately 25,000 connections per year for the next decade to cope with the targets to achieve 70% and 35 % grid access in urban and rural areas respectively requires adequate resources. Deployment of a strategy and corresponding means based on connection forecasts is a must. LEC has to perform detailed analysis of the resources needs, including: equipment, staff and corresponding investments and working capital. Enlarging the customer basis is one of the prerequisites for strong interest of private investors in the generation segment of the sector.

14.2 REGULATION FOR RURAL ELECTRIFICATION

The RREA Act has mandated the RREA to be responsible for rural electrification and the LEC is currently concentrating its actions and activities mainly in the Monrovia area. For some years now, LEC's capacities in other regions (rural) are very limited. The RREA should therefore be mandated to take charge of the cross border rural electrification project in progress, giving the RREA the authority to organize IPPs in the rural communities served by this project. The Cross Border power supply project is already supplying power and there is urgent need to empower the RREA to engage with the local communities to develop off-taker enterprises and power distribution, management and maintenance capacity including pilot programs for the promotion of grid extension, mini-grids or dispersed stand-alone systems management taking into account the projected access targets legal frameworks and obligations for rural electrification.

It shall be a policy that the LEC will be responsible for the CLSG interconnection project and the policy requires that LEC has the authority and the resources to operate in the regions where the WAPP transmission lines are located to effect wheeling agreements with IPPs. LEC is therefore formally in charge of developing and operating the electric system/network out of Monrovia area in the framework of the WAPP-CLSG transmission lines network, while the mini-grids and off-grid systems operators are responsible for their respective operational areas within their license.

The LEC's statutory role, functions, scope of tasks and responsibilities shall be readjusted and fixed at the highest level; clearly defining LEC's country-wide responsibilities as they relate to IPPs, RREA and other players in the power sector of Liberia shall operate in line with the new reforms. The laws, bills and decrees ruling the LEC and its role and activities shall be analysed and revised. The cross-border power supply project is already supplying power and therefore the local communities shall be empowered to develop off-taker enterprises and power distribution, management and maintenance capacity.

14.3 OTHER REGULATORY AND PRIORITY RURAL ELECTRIFICATION

14.3.1 Civil Society Engagement

Civil society partnerships under the NREAP will aim to empower Liberian citizens to hold government, utilities and power pools accountable. Interventions will be designed to assist Civil Society Organizations (CSOs) build

constituency support and encourage civic activism and participation; empower CSOs to conduct power sector oversight and advocate for implementation of transparent and equitable electricity policy; and establish networks and platforms for greater access to electricity, cooperation and solidarity between CSOs. Civil society representation will be diverse and inclusive, with extra care to empower highly marginalized and communities underserved with electricity (women, youth, the poor, the elderly, ethnic or geographically based minorities, and the disabled and hospitals and clinics) to benefit from the reform process.

14.3.2 Gender Mainstreaming in the Energy Sector

As a part of the NREAP the GOL will encourage concrete demonstration of innovative, gender sensitive and alternative framework and support programs on gender mainstreaming to work with rural electrification in areas that are not likely to be connected to the grid in the foreseeable future including a program for massive deployment of solar systems for homes, clinics and schools. The GOL shall assist in building the capacity of energy related ministries and departments to consider the challenges and needs women face concerning energy use and access. Technical assistance can focus on developing clear and explicit gender-related goals and objectives within the framework of gender mainstreaming in the energy sector. Women are not only valuable domestic and commercial consumers who have demonstrated a tendency to pay their energy bills on time; they are also energy entrepreneurs who can help broaden the use of modern energy technologies. Women are social advocates who can raise community awareness about energy-related opportunities and give attention to the unique challenges women and marginalized communities (such as the disabled) face in access to energy. Women are capable technicians and managers who bring enormous value to the energy industry. Women's energy choices can be different from those of men, and the social and economic benefits of increased energy access may be different for women compared to men. In this context, Liberia will continue to cooperate with the ECOWAS Program on Gender Mainstreaming in Energy Access (ECOW-GEN) of ECREEE and, specifically, with the implementation of the Framework Action Plan on 'Women's Economic Empowerment through Energy Access in the Mano River Union (MRU).

14.4 ELECTRICITY NETWORK OPERATION

The transmission and distribution of electricity from renewable energy sources is to be guaranteed by transmission and distribution system operators, and priority or guaranteed access is provided. The GOL shall adopt clear legislation that defines the procedure for granting permission to link production plants to the public network.

The GOL through the RREA shall develop a study on the impact of incorporation of RES in the grid (grid stability) and to ensure that RE generation is encouraged. The GOL shall further conduct net metering and tariff reviews and introduce appropriate mechanisms for net metering and standards to encourage the development of renewable energy.

With the backdrop of the Millennium Challenge Corporation's (MCC) US$ 257 million "Compact Agreement", and the eventual expiration of the current MHI Management Contract for LEC, the GOL shall appropriately restructure the LEC along the spirit and intent of the new *2015 Electricity Law* which effectively changes the LEC previous mandate as a government utility company with the nationwide exclusive authority over electric power operations and transactions.

14.5 INITIAL MINI-GRIDS PROJECT PIPELINE

The following projects were in the pipeline prior to the recent Ebola Virus Disease outbreak, which need to be reactivated because of their high value within the context of the NREAP target, stand alone and small-medium scale projects.

14.5.1 Proposed Rural Municipal Mini-Grid Projects

The following nineteen (19) projects are earmarked as the initial priority rural mini-grids pipeline to commence the Rural Mini-Grids Rollout Development Program that could be run as Mini-Grids under Private Sector IPPs transactions system. Some of these projects have potential hydroelectric resources within their proximity or solar energy potential that could be developed as either mini-hydro based, or as solar PV-Battery System or hybrid hydro-solar application systems. The management structure need to be studied for the options of either local cooperative of combined into regional mini-grid scheme to enhance project commerciality, economics of scale and management capacity advancement. See the map below.

- Barclayville – Mini-grid for the city power;
- Bellefanai – Mini-grid for the city power;
- Bopolu – Mini-grid for the city power;
- Buchanan - Mini-grid for the city power and Municipal Water Supply;
- Cestus – Mini-grid for the city power;
- Fish Town – Mini-grid for the city power;
- Foya – Mini-grid for the city power and Municipal Water Supply;
- Ganta – Mini-grid for the city power;
- Gbarnga - Mini-grid for the city power and Municipal Water Supply;
- Greenville – Mini-grid for the city power;
- Harper – Mini-grid for the city power;
- Kakata – Mini-grid for the city power and Municipal Water Supply;
- Kolahun – Mini-grid for city power
- Roberts Spot – Mini-grid for the city and Municipal Water System;
- Saniquellie – Mini-grid for the City and the Municipal Water System;
- Tapita – Mini-grid for the city power and Municipal Water Supply;
- Vonjama – Off-grid for the City and the Municipal Water Project
- Zorzor – Mini-grid for the city
- Zwedru – Mini-grid for the city power and Municipal Water Supply

Development of these mini-grids should begin with an assessment of the available local RE resources base to determine the appropriate technology. See the Map Below of Proposed Mini-Grids Locations.

Map of Proposed Mini-Grids Locations

14.5.2 The Small-Scale Solar Lighting Projects - Stand Alone Projects

Street and Traffic Control and Schools Solar Lighting

Solar street lighting has been successfully demonstrated in Liberia (e.g. Caldwell Solar Street lighting and solar powered traffic control lights on major junctions of the streets of Monrovia). It has also been demonstrated that police substation depots can effectively utilize solar lighting systems. In this view, the NREAP includes as a first impact priority program, the installation of solar lights at selected target points as component in the implementation of the following proposed and ongoing roads and construction projects and specified sites:

- Solar PV Lighting for MVTC School Compound – classrooms, streets and offices;
- Redlight-Gbarnga (OPRC Lot 31) – Support for solar PV for traffic lights at selected junctions and checkpoints and warning signs;
- Gbarnga-Ganta-Guinea Border (OPRC LOT #2) – Support for solar PV for traffic lights at selected junctions, border post, checkpoints and warning signs;
- Ganta-Yekepa Road Project – Support for solar PV for traffic lights at selected junctions and checkpoints and warning signs;
- Freeport-Redlight (Somalia drive) – Support for solar PV for traffic lights at selected junctions and checkpoints and warning signs;
- New Caldwell Bridge - PA support for solar PV for traffic lights at bridge crossing checkpoints and warning signs;
- Police Academy Road – Support for solar PV for traffic lights at selected junctions and checkpoints and warning signs;
- Shefflein-Marshall Road - Support for solar PV for traffic lights at selected junctions and checkpoints and warning signs;
- Fish Town-Harper Road Phase 1 – Support for solar PV for traffic lights at selected junctions and checkpoints and warning signs;
- Kolahun-Vahun Road – Support for solar PV for traffic lights at selected junctions and checkpoints and warning signs;
- Gbarnga-Mendicorma (Lot #1 – Gbarnga-Kornea) – Support for solar PV for traffic lights at selected junctions and checkpoints and warning signs;
- Gbarnga-Mendicorma (Lot #2 – Kornea-Mendicorma) – Support for solar PV for traffic lights at selected junctions and checkpoints and warning signs;
- Kakata-Bong Mines – Support for solar PV for traffic lights at selected junctions and checkpoints and warning signs;
- Sinkor Streets & Avenues – Support for solar PV for traffic lights at selected junctions and checkpoints and warning signs.
- AB Tolbert/Weaver Street – Support for solar PV for street lights and for traffic lights at selected junctions and checkpoints and warning signs.
- Clara Town Road – Support for solar PV for street lights, traffic lights at selected junctions and checkpoints and warning signs.
- Main Du Port Road – Support for solar PV for street lights, traffic lights at selected junctions and checkpoints and warning signs.

Solar Lighting for Immigration Border Posts and Police Deports

Solar Lighting for Immigration Border Posts and Police Deports across the Country. This is estimated at about 50 border posts and at least 40 – 50 police deports across the country.

15.0 RENEWABLE ENERGY APPLICATIONS FOR DOMESTIC USES

15.1 IMPROVED COOKING STOVES

In order to encourage the use of Improved Cooking Stoves that meet standards, first of all, studies will be undertaken to adopt a standard for improved cooking stoves, and capacity building program will be supported to help stove producers improve the production techniques and processes. Specific Measures for the promotion of efficient cook-stoves will be instituted and training materials will be presented/ disseminated to stove producers this shall include conducting market assessment for clean cook-stoves in order to check the viability of market expansion and the implications for households. These measures will be specified and implemented in coordination with the West African Clean Cooking Alliance (WACCA), the ECOWAS Initiative for safe, sustainable, affordable and clean cooking.

15.2 EFFICIENT CHARCOAL PRODUCTION

The organization of the fuel wood and charcoal industries in Liberia does not fit with the environmental and modern energy development challenges even though the charcoal production, transportation and utilization is a large industry employing and providing income to tens of thousands in the various points of the chain. Biomass fuels contribute by more than 95% to the cooking and water heating energy sources, which is a threat to the environment and health. Sensitization campaigns must be planned in order to inform and educate the various actors of the sector. A study on the consequences of switching from the use of biomass energy to modern energy that the SE4ALL goals will ultimately bring to the population will be conducted. Improved efficient charcoal production technologies will be introduced and studies including capacity building will be undertaken.

The use of biomass fuels (fuel wood and charcoal) is not efficient. The current production techniques and the end users practices are not optimized. Local wood and charcoal cooking burners (stoves) referred to as “Cole Pots” are not efficient. Campaigns and pilot projects will be organized, financed and launched in order to develop the use of efficient kiln technologies for the production of charcoal. The same shall be implemented for the development, promotion and utilization of improved stoves by end users. The Forestry Development Authority (FDA) shall allocate resources and pursue information actions for sensitization of actors of the charcoal production industry including the National Charcoal Production Association (NCPA) on the aspects of forest management and the use of more efficient charcoal production techniques as a conservation and EE measure. FDA shall also introduce fast growing firewood plantations for energy purposes.

USE OF MODERN FUEL ALTERNATIVES FOR COOKING

Modern fuel alternatives for cooking such as electricity, LPG, biogas, solar cookers shall be encouraged and vigorously promoted including campaigns and education, financial support to entrepreneurs and NGO’s, and commercial outlets, which will be undertaken to meet the targets of the SE4ALL for Liberia.

15.2.1 Bio-fuels–Sustainability Criteria and Verification of Compliance

At present, there is a lack of strategy for replacement of biomass fuels by modern energy. Bio-fuels and charcoal industries are currently providing activities and revenues to many people. The GOL strategic measures on Bio-fuels shall be undertaken with a plan to meet the projected targets of this NREAP and to manage the transition towards the use of modern energy. Information and other incentives and initiatives shall be provided for the actors who will undertake re-conversion of their current energy production facilities to bio-fuel uses as long as the production and use of biomass energy will decrease.

The GOL will undertake to provide incentives for the utilization of national bio-fuels, and to develop a process to identify the national authority/body that is responsible for monitoring the compliance of the bio-fuels with sustainability criteria and for certification of bio-fuels. Moreover, the GOL will provide information on the land areas that can be used for the production of bio-fuels.

The agriculture sector and environmental management laws of Liberia will be taken into consideration in compliance with good agro-environmental practices and other cross compliance requirements.

16.0 CAPACITY BUILDING OF TECHNICAL STAFF FOR RE IN ELECTRICITY

There are delays in preparing the next generation of hydropower projects located in the various river basins of the country despite large hydropower resources. The GOL shall make all efforts to accelerate the studies for the Via Reservoir project intended to ultimately increase the generation capacity at the re-commissioned Mount Coffee power station, the EU has submitted ToR for the reconnaissance study and the follow on comprehensive feasibility study to the MLME, and has pledged finance for both of them.

MLME and the DOE will incorporate a hydropower specialist in their staff, given the increasing importance of this sector for the near future.

The MLME and specifically the DOE are the responsible entities for the management of the energy sector; however they are lacking adequate human resources. The RREA is in need of Technical Manpower Capacity. The RREA needs to recruit additional technical manpower, such as engineers to develop a technical department. It is therefore a plan to commission a diagnostic study of the current human resources and for determining the needs in line with responsibilities and tasks of the DOE and NECL. The study will also encompass diagnosis of logistic means (office space, office equipment, integrated computerized system, vehicles) as well as training courses and programs.

The study must be performed by an independent external specialized firm. Funding may be obtained within donors' supported Technical Assistance programs.

16.1 FINANCIAL SUPPORT FOR INVESTMENT

Local banks are reluctant to allow long maturity loans to private operators. The banking industry shall be required to observe good practices and exercise strict governance in analysing credit applications. It shall be a policy measure of the GOL for loans and financing facilities by banks and the RREA to provide guarantees for loans to be extended according to the merits of the projects established through impartial due diligence.

Presently private sector participation is limited and there are few potential private investors and operators for the energy sector. Potential investors and operators in the energy sector lack information and experience. Seminars and information workshops shall be organized through GOL and donor support for presenting business opportunities offered by the energy sector development. Workshops and seminars should be jointly organized with the participation of the MLME, the local banks, the business associations and other donor organizations.

The information on possible projects remains confidential or limited to a restricted number of actors. Reliability of information is often uncertain. The Government/Authorities should maintain transparency and equity for the information relating to energy and power projects which may be of interest for private investors.

The RREA is embarked on developing a Rural Energy Master Plan, and the validation process shall ensure that the NREAP and the RREA Rural Energy Master Plan are aligned with each other. A clear sectoral development master plan is a prerequisite for the establishment of a credible list of projects and business opportunities. The development of the master plan is a present priority for the RREA.

16.2 REGIONAL COOPERATION, INTEGRATION AND CONFERENCES SUPPORT

In order to ensure coordination with regional and other international energy agencies, Liberia must reaffirm its membership to regional organizations. The GOL shall ensure that the appropriate **Focal Persons** are designated for attending to each of them (WAPP, other National Electric Utilities in neighbouring countries, ECOWAS programs, etc.). The appropriate qualified persons shall be carefully selected, prepared and nominated to attend and participate in such meetings and sessions as delegates from the Government (e.g. MLME, DOE, LEC, and MOFDP, and others), and shall be timely funded (including provision for such expenses in the budget) for exchanging and sharing experiences and policies, bringing back the best added value from such meetings and developing synergies for the creation of a regional electricity market.

Donors shall be strongly encouraged by the government to support regional integration in the power sector, providing financial support and technical assistance as well as human resources for the organization of meetings, workshops and the establishment of regional policies and strategies. The African Union (AU) is currently piloting the PIDA (Plan for Development of Infrastructure in Africa) assisting member countries to prepare and promote regional projects.

16.3 SUPPORTING THE NREAP-NEEAP-SE4ALL INITIATIVE IN LIBERIA

The GOL is seeking support from investors, donor agencies and friendly nations for the resuscitation of the power sector as well as to boost investments and straighten local businesses that are relying on private power provisions. In addition to efforts the GOL and friendly governments are providing through which parts of Monrovia are currently benefiting from power provided by the LEC through USAID, Japan, Norway and the GOL power project, the GOL and MLME officers need to be fully conversant with the facilities, funding tools and opportunities specifically put in place for supporting the further stages of the NREAP-NEEAP-SE4ALL initiatives. This includes the need for thorough acquaintance with the terms and procedures for the utilization of the following:

- The 400 M€ grant lending facility allocated by the European Commission and for the assorted Technical Assistance Facility of 65 M€.

- Other donors-led initiatives like the SEFA (Sustainable Energy Fund for Africa by the African Development Bank) and many others are available.

- Power Africa (PA) has the objective of electric power generation support initiatives including support for utility and energy sector reforms to pave the way for investments and growth, including the initiative for PA to trigger the support of a wide range of U.S. Government (USG) tools for investments in the energy sector ranging from policy and regulatory best practices, to pre-feasibility support and capacity building and long-term financing such as insurance, guarantees, credit enhancements and technical assistance to help partners expand generation capacity and access, committing U.S.G. support of over $7 billion for Africa over the next five (5) years.

- U.S. Agency for International Development (USAID) has funds to provide $285 million in technical assistance, grants and risk mitigation to advance private sector energy transactions and help governments adopt and implement the policy, regulatory, and other reforms necessary to attract private sector investment in the energy and power sectors.

- The Overseas Private Investment Corporation (OPIC) has plans to expend up to $1.5 billion in financing and insurance to energy projects in sub-Saharan Africa.

- The U.S. Export-Import Bank (Ex-Im) will make available up to $5 billion in support of U.S. exports for the development of power projects across sub-Saharan Africa.

- The Millennium Challenge Corporation (MCC) will invest up to $1 billion in African power systems through its country compacts to increase access and the reliability and sustainability of electricity supply through investments in energy infrastructure, policy and regulatory reforms and institutional capacity building. Already, as mentioned above, the MCC and GOL have signed the agreement for the grant of $257 million Compact.

- The OPIC and the U.S. Trade and Development Agency (USTDA) will provide up to $20 million in project preparation, feasibility and technical assistance grants to develop renewable energy projects. These efforts will be coordinated through the U.S. - Africa Clean Energy Finance Initiative (US-ACEF) and supported by the recently launched U.S. - Africa Clean Energy Development and Finance Center (CEDFC) in Johannesburg, South Africa.

- The U.S. African Development Foundation (USADF) will launch a $2 million Off-Grid Energy Challenge to provide grants of up to $100,000 to African-owned and operated enterprises to develop or expand the use of proven technologies for off-grid electricity benefitting rural and marginal populations.

- EnDev/GIZ is working in the field of renewable energy technology program in Liberia. In brief: the EnDev/GIZ led by its local Director Harttieh Euler is making efforts to develop the Solar Energy Market promotion, training, innovation, planning, distribution and post-ebola installation of fridges and freezers for the cold chain in health are ready for installation (delivery, women) and for schools; several solar installations are ready for the health sector. The following have also been installed: solar installations in the health and increasingly in the school sector; small and medium sized solar home systems; stoves, pico-PV light systems and operation of a running hotline for service and repair; Do regular training workshops and seminars at University, Vocational Training Schools. They do energy audits for larger systems and work on mini-grid development, school systems for E-learning and larger commercial installations focusing the private sector.

These initiatives and tools are specifically designed in line with the three (3) goals of SE4ALL. Liberia is fully eligible. Utilization is nevertheless on a “first come first serve” basis. It shall be the plan of the GOL as a priority to appoint an experienced person permanently sited at the MLME or DOE as the officer specialized on these funding facilities and their procedures.

Financial support can be classified in various ways. Examples are: financial support for investment, capital grants, low interest loans, tax exemptions or reductions, tax refunds, tax holidays, tender schemes, renewable energy obligations, feed-in tariffs, feed-in premiums, voluntary schemes, micro credits, loans and production sharing. The government shall undertake to pursue some or all of these financial schemes on the case by case bases through a systematic analytical assessment of power development projects/programs.

Two key issues that need to be addressed are increasing the access to electricity and reducing the cost of electricity to customers. This may be done by expansion of the Monrovia LEC’s generation transmission and distribution capacity and improving the quality of services. But the cost of expansion makes cost recovery a difficult challenge. The cost of production may be reduced in the long run with the use of RE resources. With the current low capacity and small customer base, funding expansion through the revenue collection is impossible even at the current high tariff rates. Financial support by donors is therefore required in order to soften the transition between a situation of high production costs and high tariffs, and to enter into production of less costly sources (like solar PV). Utilization of subsidizing tools is the recommended measure for filling the gap accumulated during several years of electricity poverty in the sector. LEC, RREA and the Government shall therefore strongly encourage and promote projects which improve the system energy mix as it is expected that RE resources will in the long run have lower production costs than costly fossil fuels.

16.4 SENSITIZATION AND INFORMATION CAMPAIGNS

The GOL shall support sustained sensitization and information campaigns, explaining the benefits of renewable energy to the public, the costs for energy services and the Government's existing and planned measures to reduce these costs to the consumer.

16.5 ELECTRICITY TARIFFS AND FEED-IN-TARIFFS

Electricity Tariffs

The current Liberian electricity tariffs paid by the general public are the highest in the region. It is believed that the tariffs are high due to real production costs, however, observations show that there is an exaggerated perception of risks from investors and private sector participants which may be factored into the tariff determination. There is a need for the GOL to review the current electricity tariffs being charged the public.

Feed-in Tariffs

In order to encourage private sector participation, one of the options now becoming popular in the electric power generation world-wide is the use of Feed-in-tariffs (FITs). The GOL will introduce feed-in-tariff (FITs) schemes as well as some types of tariff levies, and criteria for differentiating tariffs, fixed tariff guarantees and other foreseeable schemes particularly in cases where investors such as mining concessions are encouraged to expand production beyond their internal energy needs to feed the excess capacity into the grid.

The GOL shall make comprehensive review and analysis of the various options available for encouragement and promotion of private sector participation in the electricity supply sector. The perception of high risk by prospective investors, operators or developers could result in biased financial evaluation of projects that could eventually factor into offering prohibitive tariffs. Transparency in managing concessions awards, tariffs computations and operator remuneration must be translated into the regulatory framework and in the text of applicable laws. Delegating generation to the private sector under appropriate rules and monitoring systems is one of these measures. Transparent analysis of costs and tariffs must therefore be conducted in order to determine the true and fair price of electric energy in Liberia. Such an analysis shall be the basis and the promotion tool for capturing the interest of the private sector.

The enabling environment for institutional and private sector participation in the energy/electricity sector and the experience in Liberia is lacking or relatively new. GOL shall pursue opportunities for engaging in Private Public Partnership (PPP) structures and the regulations for such opportunities shall be put in place. Relevant laws and regulations as well as models for concession contracts, off-taker agreements, tariff adjustment rules and tendering/award procedures shall be updated, finalized and enforced. The National Electricity Regulatory Commission which has already been created as part of the 2015 Electricity Law of Liberia shall be given the enforcement powers needed to begin moving with electricity transactions process.

16.6 TENDERING:

There are no recent projects with private sector participation which could serve as a model/demonstration for officials to be conversant with the procedures and practices required for win-win deals. This has caused the lack of experience and practice in PPP's in the energy sector. The GOL shall as soon as practicable develop the rules, procedures and organization for tendering GOL and donor supported power sector development projects and the procedure for approval of feed-in-tariffs as discussed later in this document. This shall include using tendering procedure to determine the level of feed-in-tariff or feed-in-premium that will be paid to the investor. The tender would request investors to state the price/kWh at which they would develop a particular project and will grant the project and a feed-in-tariff to the investor offering the lowest price. In this way the size of the feed-in-tariff would be linked to the tendering process of a particular project and not defined in advance by the

government.It is necessary to now use selected transactions (those which are in the current pipeline) as training-on-the-job opportunities for government officials (on economic, financial, engineering, procurement and legal aspects.) with the support of consultants. The Technical Assistance facility offered by the EU as well as other initiatives (SE4All, SREP, GEF, IFC) are possible resources which shall be pursued to develop the GOL own Support Transactions Advisory Services in Liberia. The GOL may want to consider the possibility of using the tendering procedure to determine the level of feed-in-tariff or feed-in-premium that will be paid to the investor. That is, the tender would request investors to state the price/kWh at which they would develop a particular project and will grant the project and a feed-in-tariff to the investor offering the lowest price. In this way the size of the feed-in-tariff would be linked to the tendering process of a particular project and not defined in advance by the government.

The Government is committed to enforce, implement and make operational the laws and measures which are well defined and described in the National Energy Policy of Liberia for reassuring private investors and all players in the power sector. In order to close the gap in appropriate feasibility studies and socio-economic linkages of planned projects, new generation, transmission, and distribution projects shall be listed based on the obvious priorities as needed to satisfy the future demands. This list shall be developed and prioritized through the process of the investment prospectus development for the power sector of Liberia. Intended projects for the development of the Liberian electric/energy system shall be technically and socio-economically evaluated in compliance with good practices respecting the requirements, constraints and procedures of donors who may further finance these projects. The NREAP-NEEAP-SE4All action agenda is intended to serve as the consolidated development master plan for the sector providing a credible list of priority projects which to be eligible for co-funding by the donor's community.

1.1 MANAGEMENT OF RURAL ELECTRIFICATION

LEC is currently concentrating its actions and activities mainly in the Monrovia area. LEC's capacities in other parts of the country (rural areas) are very limited. The cross border rural electrification as well as the CLSG interconnection projects is in progress. The GOL shall require that LEC has the authority and the resources to operate in the regions where these cross border projects are located. The GOL shall confirm that LEC is formally in charge of developing and operating the electric system/network out of Monrovia area. In this regard, adjustment of LEC statutory role, function scope of tasks and responsibilities shall be fixed at the highest level (LEC Country-wide responsibilities) The GOL shall in this regard undertake a review and analysis of the laws, bills and decrees ruling the LEC's role and activities for rural electrification to open it up to other players. The cross-border power supply project is already supplying power in this connection, the GOL shall, under the overall Master Plan for Power Development, empower the local communities to develop off-taker enterprises and power distribution, management and maintenance capacity. Other management schemes, systems and options will be pursued including – licensing of local electricity cooperatives, regional mini-grids, off-grid power supply and stand alone schemes power distribution mechanisms.

There is presently insufficient consideration of the hydropower sector as required for the long term development of power in Liberia. Data and information on the river basins (hydrology, land use, environmental issues, power generation potentials and feasibility, etc.) are outdated and should be updated according to today's good practices and technology requirements. River basins other than the St Paul River (St John, Mano and others rivers) must be surveyed and studied for identifying sites and feasible hydropower projects. Such studies might be linked to the establishment of the National Development Master Plan in order to prioritize the projects and establish projections regarding the resources they will mobilize from the Government itself and from donors and possibly Private Sector Participants.

This action plan includes the development of critically required Financial Support Schemes (FSSs) for Rural Electrification Programs. These FSSs must project funding schemes based on the specific project types and the set of FSS applicable will be decided by the GOL. FSS options available include but not limited to: subsidies; capital grants; low interest loans; tax exemption or reduction; tax refunds; tax holidays; import/export duty exemptions; technical assistance; training sponsorships; etc. and these support schemes will be managed by the RREA to benefit both government owned and the IPPs involved in RE or hybrid electricity production systems

and other power sector educational and managerial capacity building support including business and managerial advisory services all dependent on the given project.

1.2 SPECIFIC MEASURES FOR THE PROMOTION OF EFFICIENT COOK-STOVES

The DOE and the RREA are committed to initiate the promotion of efficient cook-stoves, including improvements in the current popularly used "Coal-Pot" in Liberia, introduction of modern fuels and cooking technology equipment and introduction of conservation measures. This program will for example include:

- Information campaigns on clean and efficient Cook-stoves targeting different needs for rural and urban areas as well as men and women.
- Using modern fuel alternatives for cooking (LPG, biogas, ethanol, solar cookers, ovens, electric stove, heaters, etc.) shall be promoted through either tax incentives, or direct promotional programs and support of institutions undertaking the sensitization and distribution schemes.
- The Fuel Switching programs will be in line with the above tabulated concrete obligations / targets per year which will be planned in details to specify per fuel or technology – LPG, electricity, etc. to meet the annual trajectories for the period 2010 to 2030.
- Biomass has an important role as primary energy for cooking in rural and peri-urban areas in Liberia and will continue to do so for the foreseeable future. The GOL shall provide support for fuel substitution awareness programs which are seen to be very seriously and will prioritize them through intensive support for achieving the SE4All targets and objectives. Local groups such as the Charcoal Industry Association, etc. will be encouraged to engage in conservation and efficiency action plans.

1.1 BIOMASS USE (FORESTRY RESIDUES, MUNICIPAL WASTE, AGRICULTURAL WASTE)

The National Renewable Energy Laboratory (NREL) in 2009 conducted an Assessment of Biomass in Liberia for USAID under the Liberia Energy Assistance Program (LEAP). The findings of the NREL study indicate that a variety of biomass resources exist in Liberia in large quantities - more than enough to cover the country's annual electricity consumption of approximately 297GWh and oil consumption of approximately 206 dam^3 with opportunities for expansion for electric power generation using biomass technologies. The local production and use of biomass resources as substitute for fossil-based fuels offers many socio-economic and environmental benefits for Liberia including energy security, investment opportunities, job creation, rural development, decreased greenhouse gas (GHG) emissions, waste utilization, and erosion control. However, if not managed properly, biomass resource development could have negative impacts, particularly to the environment.

The GOL shall encourage and support the use of biomass-based renewable electric power generation technologies including biodiesel, solid biomass fuel generation and programs for production of biomass field lots for energy uses. The GOL shall also undertake or support studies in details to assess the socio-economic and environmental implications and impact of biomass resources development in order to guide appropriate national policies and measures.

Table 33 below presents the potential and existing biomass resource base for bio-power and bio-diesel generation capacities in Liberia.

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TABLE 33: BIO-POWER AND BIO-FUELS FROM EXISTING AND POTENTIAL BIOMASS RESOURCES IN LIBERIA

	EXISTING RESOURCES			POTENTIAL RESOURCES				
COUNTY	Bio-Power From Food Crops Residues (GWh/yr)	Bio-Power From Cash Crops Residues* (GWh/yr)	Bio-Power From Cash Forest Residues (GWh/yr)	Rank	Biodiesel** (dam3/yr)	Ethanol*** (dam3/yr)	Bio-Power From Cash Crop Residues**** (GWh/yr)	Rank
Bomi	1.4	25.1	0	11	152	94	1,660	6
Bong	32.6	105.5	0.04	3	499	308	5,435	1
Grand Bassa	8.2	66.2	0.15	5	318	196	3,465	3
Grand Cape Mount	1.6	32.5	0.15	10	147	91	1,604	8
Grand Gedeh	6.4	9.8	3.88	12	21	13	231	14
Grand Kru	1.8	5.5	1.15	15	93	57	1,012	9
Lofa	18.9	46.9	0.88	6	287	177	3,121	4
Margibi	8.8	114.7	0	4	148	92	1,614	7
Maryland	8.8	32.2	0.24	8	73	45	793	10
Montserrado	35.8	184.9	0	2	0	0	0	15
Nimba	45.6	313.3	1.76	1	461	286	5,053	2
River Cess	2.1	8.5	2.88	14	57	35	620	11
Sinoe	5.1	32.1	0.97	9	27	17	292	12
River Gee	3.9	12	2.19	13	24	15	261	13
Gbarpolu	7.4	40.5	0.98	7	162	100	1,764	5

1 dry tonne of biomass = 1.5 MWh of electricity (20-40% efficiency); * The total doesn't add up to total for the whole country. The analysis by county excludes residues from replanting. There would be different removal rates depending on local tree stock conditions; * Includes palm and coconut oil -using 10% of available cropland for oil palm and 10% for coconut tree; *** Using 10% of available cropland for sugarcane; **** Includes oil palm, coconut, and sugarcane residues -using 30% of available cropland -10% for each crop.

2.0 ARTICULATION WITH REGIONAL INITIATIVES

The ECOWAS region has a series of on-going regional initiatives on the field of renewable energy as follows:

1. The ECOWAS White Paper on a Regional Policy for Increasing Access to Energy Services in Peri-Urban and Rural Areas by 2015;
2. Establishment of ECREEE;
3. Adoption of the ECOWAS Renewable Energy Policy (EREP) with targets for 2020 and 2030;
4. The ECOWAS Small Scale Hydropower Program;
5. The ECOWAS Solar Thermal Program;
6. The ECOWAS Bio-energy Strategy Framework; and
7. The ECREEE Rural Electrification Program.

A summary of these regional initiatives in renewable energy can be found in **Annex I of this NREAP**.

Besides the activities in renewable energy, the ECOWAS region has also a series of on-going activities in energy access:

1. The ECOWAS White Paper on a Regional Policy for Increasing Access to Energy Services in Peri-Urban and Rural Areas by 2015;
2. The ECOWAS Revised Generation and Transmission Master Plan;
3. The West Africa Gas Pipeline (WAGP); and
4. ECOWAS Rural Electrification projects.

A summary of the regional initiatives on energy access can be found in **Annex II.**

Synergies between these regional initiatives and the proposed measures in this NREAP will be created.

3.0 PREPARATION OF THE NATIONAL RENEWABLE ENERGY ACTION PLAN

3.1 PROCESS FOR THE NREAP-NEEAP-SE4ALL

This National Renewable Energy Action Plan (NREAP) is developed in line with the SE4ALL Action Agenda and the National Energy Efficiency Action Plan (NEEAP), all of which have the objective of Liberia meeting the ECOWAS regional targets by 2020 and 2030. To support this planning process, ECREEE and its partners provided support for national and international experts to assist Liberia. The Liberian National Consultant, supported by ECREEE is Prof. Jacob S. Sandikie, working with a local counterpart team of professionals from the Department of Energy, MLME and the RREA. They were assisted by a backstopping consultant, Roman Ritter. After Ritter's service ended, ECREEE appointed a new strong backstopping team comprising i) Mr. Leonardo Barreto-Gomez, ii) Ms Cornelia Schenk, and iii) Ms Andrea Jamek from the Austrian Energy Agency (AEA) and iv) Ms Sofía Martinez from the Spanish Institute for Energy Diversification and Saving (IDAE). Other partners are also working with Liberia to support the Action Plans.

4.0 FOLLOW-UP ON ITS IMPLEMENTATION

In order to fulfill the quantitative and qualitative targets, portfolios of bankable projects that are considered attractive for private investors and financial institutions shall be developed. In addition, the required transformations of the enabling policy environment have been proposed and concrete actions designed for the implementation of renewable energy policies are highlighted in this report. The Liberia National Energy Policy

(NEPL) contains a set of national goals and activities that must be revisited and a modern National Renewable Policy (NREP) be crafted as proposed herein if Liberia is to meet the MDGs and the SE4All targets.

The accompanying reports (SE4ALL and NEEAP and Appendix IV of this report, Calculations Parameters for the Scenarios for NREAP-NEEAP-SE4ALL) have all been developed to map out a comprehensive policy and implementation strategy based on the targets and the selected accompanying technologies covering the period up to 2030.

4.1 NREAP IMPLEMENTATION COORDINATION STRUCTURE

The RREA Executive Director is the designated Contact Focal Point for ECREEE, and is responsible for NREAP activities in Liberia.

At the launch of this NREAP-NEEAP-SE4ALL Action Plans implementation phase, a coordinator shall be appointed either in the RREA or in the Ministry of Lands, Mines and Energy. Bankable projects shall be identified in the process as input for the Investment Prospectus(es).

In developing the investment prospectus, a Financing Working Group shall be set up bringing together Government stakeholders and financing institutions. The mandates, roles and responsibilities of institutions and stakeholders shall be clearly and adequately defined within the institutional framework to implement the Action Agenda. The issue of quality control is an important dimension that will also be addressed.

4.1.1 Institutional Support to the Coordination Office for Liberia

The GOL shall develop or seek support for a sustainable software platform for storage, retrieval and sharing of information on Liberia's NREAP-NEEAP-SE4All Implementation Projects, rural electrification and off-grid activities including best practices and success stories from other ECOWAS countries and other parts of the world which can be replicated in other parts of Liberia.

The GOL shall seek Early-Stage Project Development Support, including grant funding for early-stage market study, prefeasibility studies and other development costs in collaboration with other donors and other ECOWAS RE agencies and programs.

Need to Establish a Delivery Unit for Liberia The Government of Liberia (GOL) does not have a Delivery Unit focused on the Power Sector including the related technologies, cooking and biomass supply chain, etc.. Due to the need for coordination, and continuous monitoring, evaluation and updates on the national level the GOL coupled with international and donor support, will as a priority create and effectively deploy resources to create a modern Delivery Unit in the Liberia NREAP-NEEAP-SE4ALL Coordinator's Office to engage in serious and sustainable transactions with the private sector in conjunction with the LERC and RREA. Liberia's electricity company will develop a dashboard for daily monitoring and evaluation of all power sector projects in Liberia to continuously assess barriers to progress on each project to recommend mitigation measures. The coordination office will be responsible for this Unit and shall involve participation and updates from the field and other policy and regulatory authorities in the sector. The Delivery Unit shall be adequately funded by the donors and provided vehicles and logistical support to operate for effective services delivery.

4.2 FOLLOW-UP ANALYSIS AND ACTIVITIES BASED ON PLANS AND IMPLEMENTATION SCHEDULE

The NREAP is intended to outline the national structures and the follow-up mechanisms in terms of subsequent analysis, reporting and monitoring arrangements for actions in the RE Sector. The GOL shall without delay support and/or seek assistance for the development of the follow-

up Investment Prospectus of the NREAP to accelerate the support and implementation process for the NREAP.

The Action Agenda already provides the strategic framework that needs to be followed towards achieving the SE4ALL targets, which are intertwined with the NREAP and NEEAP targets. However, there will be a need for subsequent in-depth studies and analysis in many cases.(e.g. electrification plan, priority sub-sector market mapping). The GOL shall as a priority undertake to provide and seek support to mobilize the necessary resources to expeditiously and consistently move the process forward.

4.3 LINK TO INVESTMENT PROSPECTUS(ES)

The action plan process should be followed by the development of NREAP-NEEAP-SE4ALL Investment Prospectus(es) or projects pipeline, portfolios and promotion packages with a view to mobilize the required investments to implement the three national action plans. These prospects can then be put before investors, developers, bankers, and international donor community. The work on the Investment Prospectus(es) should not be limited to large projects but also Investment Portfolios development on Liberia's SSRE and targets for 2030.

APPENDIX I: SUMMARY TABLES OF POLICIES AND MEASURES

TABLE A: OVERVIEW OF REGULATORY, POLICY, ENABLING ENVIRONMENT, AND ADMINISTRATIVE MEASURES						
No.	Name of The Measure	Type of Measure*	Expected Results**	Target Group And/or Activity***	Existing or Planned	Start And End Dates of The Measure
1	Identify obstacles related to authorization, certification and licensing procedures applied to Grid, Mini-Grids, and Off-grids renewable energy power plants, and electricity transactions and take the necessary steps to eliminate them	Administrative Procedures	Speedy RE and other electricity development and investments	Rural and Peri-Urban Communities and RE developers, LERC, MLME, DOE, RREA	Planned	2016 onwards
2	Create standardized procedures for authorization of RE plants, including grid connected and off grid ones	Administrative Procedures of the LERC, MLME, DOE, RREA	Behavioral Change and published standards for reference	RE Plants and grid network operators, investors and developers	Planned	2016 onwards
3	Set up clear legislation that defines the procedure for granting permission to link production plants to the public network (renewable & fossil)	Administrative Procedures of the ERC, MLME, DOE, RREA	Transformation and clearly defined process including capacity considerations	Off-grid, and grid networks operators and investors	Planned	2016 onwards
4	Ensure coordination between grid infrastructure approval and other administrative procedures	Harmonization of Regulations	Investor confidence and increased investments	Developers entrepreneurs and investors	Planned	2016-2030
5	The NREAP re-affirms the 2015 Electricity Law of Liberia, which creates an Independent Liberia Electricity Regulatory Commission (LERC; "Regulator") and empowers it to enforce the improvement of the efficiency of the system and compliance with established benchmarks, procedures and standards	Administrative Procedures, Independent regulatory environment	A functional active and operational NERC, RREA, LEC and DOE with enforcement powers and clear separation of powers and mandates for the RE Action Plans	Off-grid, and grid plants and networks operators and investors and Environmental evaluators	Existing	2016 onwards
6	Continuously review the existing internal regulatory framework for performance, strengths, weaknesses and lessons learnt while recognizing the implications of external dimensions and formulate and implement programs of	Administrative Procedures and Spatial Planning	RE Generation Capacity increases	Rural Population End Users	Planned	2016 Onwards

TABLE A: OVERVIEW OF REGULATORY, POLICY, ENABLING ENVIRONMENT, AND ADMINISTRATIVE MEASURES						
No.	Name of The Measure	Type of Measure*	Expected Results**	Target Group And/or Activity***	Existing or Planned	Start And End Dates of The Measure
	regulatory reform					
7	Create the regulations to the Electricity Law and Strategy to: • Highlight how the utility will achieve the RE targets in the electricity supply mix (it should clearly highlight the roles of IPPs in the achievement of its targets) • Identify the process for IPPs to request licences to the utility for grid connection	Regulatory and enabling environment	RE Generation Capacity increases	Rural Population End Users	Planned	2016 Onwards
8	Develop a grid extension plan that considers the integration of RE and the improvement of electricity security.	Planners and administration	Off-grade modern building efficiency access targets achieved	Rural and Peri-urban communities and RE developers	Planned	2016 - 2030
9	Introduce legal and regulatory framework for hydropower including environmental protection standards and coordinated use of water resources	Support Schemes to promote hydropower& Nexus Energy-Water	Development of Hydro Mini-grids	Project developers, investors, general public and standards and regulatory agencies	Planned	2016-2030
10	Develop national policies to encourage mini-grid installation	Updated Regulations	Enabling environment and Strengthened process and investor confidence	Project developers, investors, general public and standards and regulatory agencies	Planned	2016 - 2030
11	Revise existing National Energy Policy of Liberia (NEPL) and RE Policy	Policy revision RE & EE Administrative and enabling environment	New and approved comprehensive NEPL that takes into account the transformed energy sector with the enabling power environmental provisions	National public and private institutions, general public other stakeholders	Planned	2016-2020

TABLE B: OVERVIEW OF FINANCING POLICY MEASURES						
No.	Name of The Measure	Type of Measure*	Expected Results**	Target Group And/or Activity***	Existing or Planned	Start And End Dates of The Measure
12	Provide an incentive package such as tax holidays for IPPs of specified capacities, duty exemption on RE equipment for licensed IPPs for a specified period of the license, to directly stimulate RE deployment	Administrative and Financial	A consistent incentive package and procedures released by the GOL	Independent power producers, project developers, and consumer public	Planned	2017 and five (5) years on
13	Implement a mechanism to set prices for IPPs	Administrative and Financial	Loan guarantees, grants, technical assistance and Increased Capacity	Investors, developers, local mini-grids, technical trainees	Planned	2016 - 2030
14	Financial Support for Investment in RE: this includes implementation of pilot projects, provision of financial support mechanisms (loans guarantees, grants, tax incentives, etc.)	Financial Support Schemes	Loan guarantees, grants, technical assistance and Increased Capacity	Investors, developers, local mini-grids, technical trainees	Planned	2016 - 2030
15	Innovative financing schemes for small RES plants (e.g. solar home systems)	Financial Support Schemes	Loan guarantees, grants, technical assistance and Increased Capacity	Investors, developers, local mini-grids, technical trainees	Planned	2016 - 2030
16	Provide an incentive package to directly stimulate off-grade RE deployment for modern cooking fuels and technologies	Financial	Loan guarantees, grants, technical assistance and equipment provision	Investors, developers, local mini-grids, technical trainees	Planned	2016 - 2030
17	Manufacturing Support Schemes to promote photovoltaic (PV) & solar thermal	Financial Support equipment duty free imports for photovoltaic (PV)	Local manufacturing	Developers and investors, Employment	Planned	2016 - 2030
18	Promote photovoltaic (PV) & solar thermal market and entrepreneurs	Financial Support Schemes to promote solar PV and thermal	Producers and commercial suppliers	Developers and investors, small scale distributers, vendors and Employees	Planned	2016 - 2030

TABLE C: OVERVIEW OF CAPACITY BUILDING, SOFT (i.e. INFORMATION CAMPAIGN) MEASURES AND POLICIES

No.	Name of The Measure	Type of Measure*	Expected Results**	Target Group And/or Activity***	Existing or Planned	Start And End Dates of The Measure
19	Development and adoption of national cooking policies, strategies and targets, including legal and regulatory mechanisms in line with the existing ECOWAS regional policies and the SE4ALL initiative in order to reach market transformation towards modern and alternative fuels and efficient devices to reduce health and environmental impacts and identification of areas of adaptation	Awareness programs strengthening of the technical and manpower capacity of the LERC and development of guidelines, policies, and regulations	Increased Access to Modern cooking	Rural, residential and public	Planned	2016-2030
20	Specific Measures for the promotion of Modern Fuel Alternatives for Cooking	Modern Fuel Alternatives for Cooking	Market availability, wide spread use of LPG, electricity, etc.	Residential sector, service institutions, modern homes	planned	2016 onwards
21	Capacity building to help stove producers improve the production techniques and processes	Develop training material to be presented/ disseminated to stove producers Conduct market assessment for clean Cook-stoves viability of market expansion	Access to modern efficient cooking methods available for rural and urban population	Stove producers, designers, developers and marketers	Planned	2020 - 2030
22	Integration of gender mainstreaming aspects in the national electric power sector planning, and strategy and decision-making processes	Gender Mainstreaming in Energy	Active participation and contribution of women in management, administration, engineering and all other aspects	Women, civil society, institutions and public	Planned	2016 onwards

TABLE B: OVERVIEW OF FINANCING POLICY MEASURES						
No.	Name of The Measure	Type of Measure*	Expected Results**	Target Group And/or Activity***	Existing or Planned	Start And End Dates of The Measure
23	Create legislation to mandate the utility(ies) to accept all RES produced from licensed IPPs through the establishment of Standards PPAs	Administrative Procedures	Transformation of the power sector	Power Producers, Public Consumers and Developers	Planned	2016 onwards
24	Define a clear structure for PPAs and adopt regulatory frameworks that allow for other power project setups in addition to utility supply (PPA) models	Administrative Procedures	Transformation of the power sector	Utilities and developers	Planned	2016 onwards
25	Guidelines for setting up grid-connected RE projects	Administrative Procedures	Transformation of the process and developed reference guidelines	National Public, Investors, Developers and Authorities	Planned	2016 onwards
26	Review on an on-going basis the existing institutional and organisational framework for performance, strengths, weakness, and lessons learnt to formulate and implement programs of legal, regulatory and policy reforms	Updated Regulations	Enabling environment and Strengthened process and investor confidence	LERC, DOE, RREA,MLME	Existing	2016 - 2030
27	Support for IPPs and increased access	Develop Requirements for National grid system to be obligated to accept electricity generated from RES	Administrative procedures and guidelines developed; Generation Capacity Increased and active projects	Grid operators, power producers, Administrative Procedures and guideline for developers	Planned	2017 onwards
28	Customs duty and sales tax exemption for import/ sale of machinery equipment and spare parts meant for the initial installation or for balancing, modernization, maintenance, replacement, or expansion after commissioning of RE	Financial support through tax exemption	Increased investments and development of mini-grids	Developers, investors and regulatory authorities MFDP, MLME, RREA	planned	2016-2030

TABLE B: OVERVIEW OF FINANCING POLICY MEASURES						
No.	Name of The Measure	Type of Measure*	Expected Results**	Target Group And/or Activity***	Existing or Planned	Start And End Dates of The Measure
	projects					
29	Set up guidelines for attracting private sector investment in the electricity sector including requirement for partnership with Liberian owned companies/firms and local content requirements	Administrative Procedures	Transformation process and clearly defined guidelines and promotional projects pipeline ready for investment	Investors, developers and Liberian owned energy companies/firms , and regulatory authorities	Planned	2016 onwards
30	Develop Tendering Procedures for Power Sector Transactions, including tariffs, and investment prospects	Financial Support Schemes	RE competitive development and transparency in operations	Investors, Developers and Managers	Planned	2016 onwards
31	Support the Rural Energy Fund for financial support schemes for rural electrification; technical assistance and training programs	Financial Support Schemes	Loan guarantees, grants, technical assistance and Increased Capacity	Investors, developers, local mini-grids and energy companies/firms	Planned	2016 - 2030
32	Create mobilisation of environmental funds for power sector. This will include the REFUND created in the RREA Act, funding from mining, agricultural and other concessions under the Social Development funds that could be allocated for power development.	Environmental support and studies	Security for customers and public both rural and urban	EPA, NERC, MLME, RREA, DOE and general public	planned	2017 onwards
33	Promote the use of Public Private Partnerships (PPP)	Financial Support Schemes	Loan guarantees, grants, technical assistance and Increased Capacity	Investors, developers, local mini-grids, technical trainees	Planned	2016 - 2030
34	Build capacity of the different actors involved in the authorization, certification and licensing activities on the procedures and standards to be applied,	Administrative Procedures	Transformation, and procurement training and recognized technical capacity	LERC, MLME, DOE, RREA, public administration	Planned	2016 onwards
35	Develop awareness	Access to	Public and	Public	Planned	2016

TABLE B: OVERVIEW OF FINANCING POLICY MEASURES						
No.	Name of The Measure	Type of Measure*	Expected Results**	Target Group And/or Activity***	Existing or Planned	Start And End Dates of The Measure
	raising and information campaigns on the process for authorisation, certification and licensing applications	Information and Administrative	Investors, Consumers and other stakeholder information program	Administration		Onwards
36	Set up a capacity building program of IPPs and the staff of the energy ministry in the field of RE	Capacity Building	RE Generation Capacity increases	Power producers, public administration, Rural Population, End Users	Planned	2016 Onwards
37	Systematic inclusion of RE and EE topics in school curriculum	Education and Vocational Training	Technical Education Materials	Vocational Institutions	Planned	2016 - 2030
38	Set up and implement Capacity Building and Awareness Raising programs for mini-grids	Support Schemes to promote mini-grids	Training programs and scholarships for RE operators	IPPs, Developers, LEC, RREA, DOE	Planned	2016- 2030
39	Develop a database that identifies offered training courses for off-grid installers certification and means of equivalency	Data base on the Installers for RE Equipment	Training for Nineteen (19) pilot mini-grids developed	Community and BTG projects	Planned	2016 – 2030
40	Capacity building off-grid management and system operations and maintenance for sustainability	Technical assistance and training programs to promote mini-grids	Increased Capacity	Investors, developers, local mini-grids, technical trainees	Planned	2016 - 2030
41	Mandate that all off-grid RE installations need to be deployed by certified installers	Certification of Installers for RE Equipment	Trained Technicians in Building energy audit programs	Installers, training institutions, public buildings and industries and mining sector	Planned	2016 - 2030
42	Develop a database that identify certified installers for Off-Grid RE with requirements for local content and empowerment of locals	Certification of Installers for RE Equipment	Support from the region and cooperation, Reliability and security	Administration, operators, installers, investors, and developers of off-grid and mini-grid RE equipment, Investors, technical trainees, civil society	Planned	2016 - 2030
43	Training of commercial users on improved fuels and cook-stove maintenance and operations	Promotion of Modern Fuel Alternatives for Cooking	Community awareness and involvement	Public local community colleges, schools	Planned	2016 - 2030
44	Ensure coordination/cooperation	Enabling Environment	Behavior Change and	Investors, developers	Planned	2016 Onwards

TABLE B: OVERVIEW OF FINANCING POLICY MEASURES						
No.	Name of The Measure	Type of Measure*	Expected Results**	Target Group And/or Activity***	Existing or Planned	Start And End Dates of The Measure
	between the different actors involved in the authorization, certification and licensing activities Create a one-stop-shop for coordinating all steps in the permission process. Create procedures to facilitate horizontal coordination between different administrative bodies responsible for the different parts of power generation permission	and Administrative	active effective coordination office			
45	Create a program linked with the ECOWAS Bio-energy Program to promote: implementation of plantation and woodlot projects to supplement wood requirements of the populations for both construction industry and for cooking	Administrative	Generation Capacity support and ECOWAS active participation in the process	End Users, wood industry, public administration	Planned	2016 Onwards
46	Develop legislation mandating the provision of information on RE, EE and EA and support the relevant agency for such information programs	Regulatory environment	Information and promotion packages	DOE, LERC, MLME, public administration, civil society	Planned	2017-2930
47	Designate a responsible authority/institution or person for coordination and public information dissemination related to the NREAP and the RE&EE&EA and support measures and funding programs	Updated Regulations	Enabling environment and Strengthened process and investor confidence	Private sector information media agencies/institutions, interested public, civil society organizations, LERC, DOE, RREA,MLME	Planned	2016 - 2030
48	Develop Information, advocacy and awareness raising measures for RE project developers; understand the nexus between renewable energy and energy efficiency and energy access	Public awareness and training	Issues are addressed and stakeholders informed	Civil society, developers, investors and service sector	planned	2016 onwards

TABLE B: OVERVIEW OF FINANCING POLICY MEASURES						
No.	Name of The Measure	Type of Measure*	Expected Results**	Target Group And/or Activity***	Existing or Planned	Start And End Dates of The Measure

TABLE D: OVERVIEW OF MEASURES ON EFFICIENCY IMPROVEMENT, TECHNOLOGY EQUIPMENT, BIO-FUELS TECHNOLOGY, SOLAR TECHNOLOGY AND BASELINE DATA, ETC.						
No.	Name of The Measure	Type of Measure*	Expected Results**	Target Group And/or Activity***	Existing or Planned	Start And End Dates of The Measure
49	Support research in renewable energy and provide financing for pilot demonstration projects	Financial	Generation Capacity Increased and active projects	Administrative Procedures and guideline developers, investors, developers	Planned	2017 onwards
50	Conduct diagnostic studies to determine power losses and key mitigation actions	Loss reduction studies	Efficiency and Access Increases	Utilities, Mini-grids, transmission and management administration	existing	2016-2020
51	Continuously monitor and create regulations to ensure adequate inventory levels to cushion any short-term disruption in electricity supply	Administrative Procedures, Policy Environments	Supply reliability and security, efficiency and management capacity	IPPs, and Grid Operators, LERC, DOE, MLME,LEC and RREA	Planned	2016 onwards
52	Improve and maintain accurate metering and billing systems for electricity	Sustainability and efficiency	Meters available for all and are reliable	Connection teams, customers and public both rural and urban	Planned	2016 onwards
53	Conduct net metering and tariff reviews and introduce appropriate mechanisms for net metering and standards to encourage the development of renewable energy	Enabling environment Transformation and Change	Increased Access to Modern cooking	Rural, residential and public	Planned	2016-2030
54	Review the tariff structure to take into account the impact of the incorporation of RES	Electricity Network Operation	RE sustainability and management improved	Priority institutions, Targeted needy and target industry access to the needy	Planned	2016-2030
55	Develop Feed-in-tariffs	Financial Support Schemes	Loan guarantees, grants, technical	Investors, developers, local mini-grids, technical trainees	Planned	2016 - 2030

TABLE D: OVERVIEW OF MEASURES ON EFFICIENCY IMPROVEMENT, TECHNOLOGY EQUIPMENT, BIO-FUELS TECHNOLOGY, SOLAR TECHNOLOGY AND BASELINE DATA, ETC.						
No.	Name of The Measure	Type of Measure*	Expected Results**	Target Group And/or Activity***	Existing or Planned	Start And End Dates of The Measure
			assistance and Increased Capacity			
56	Develop and implement programs to influence market behaviour toward sustainable energy: Encourage research development and timely and efficient implementation of renewable energy projects	Design promotional programs and conduct feasibilities and portfolio development complete and ready for investor consideration	Data base, information package, investment prospectuses	LERC, RREAP, MLME, DOE, Coordinator Office, end users, research institutions, investors	Planned	2016-2030
57	Identify perceived barriers and ways to remove the barriers for hydropower development, including policy, regulatory, institutional, legal, financial and technical issues	Support Schemes to promote hydropower	Develop monitoring and RE projects tracking scheme for prompt barriers identification	LERC, Coordinator's Office, Field Managers, DOE, RREA and IPPS, Developers	Planned	2016 onwards
58	Identify obstacles related to authorisation, certification and licensing procedures applied to renewable energy power plants, and take the necessary steps to eliminate them	Speed transactions process, enabling environment, legislative and policy framework	Transparent licenses	Investors, developers and public administration	Planned	2016-20130
59	Support research in renewable energy and provide financing for pilot demonstration projects	Research Grants	Replication in other parts	Research Institutions, Universities and DOE	Planned	2016- 2030
60	Establish procedures and conditions for installers to get the Certificate for installation of RE, including solar thermal systems, as well as conditions for	Certification of Recognized Training of Installers for RE Equipment	Trained Credibility of Technicians in Building energy audit programs	Vocational Training Institutions, installers	Planned	2016 - 2030

TABLE D: OVERVIEW OF MEASURES ON EFFICIENCY IMPROVEMENT, TECHNOLOGY EQUIPMENT, BIO-FUELS TECHNOLOGY, SOLAR TECHNOLOGY AND BASELINE DATA, ETC.						
No.	Name of The Measure	Type of Measure*	Expected Results**	Target Group And/or Activity***	Existing or Planned	Start And End Dates of The Measure
	the equivalency of training courses					
61	Develop a study on the impact of off-grid RE in the communities (acceptance, stability, sustainability, affordability)	Off-grid Electricity Network Operation	Provide information and introduce improvements on off-grid RE and improved acceptance	Rural Mini-grids operators, civil society and LERC, DOE, MLME, RREA	Planned	2016 - 2030
62	Conduct net metering and tariff reviews for off-grid systems and introduce appropriate mechanisms for net metering and standards to encourage the development of off-grid renewable energy	Electricity Network Operation	Power exchange Technical support,	IPPs and MOFDP, DOE, LERC, MLME, RREA, civil society	Planned	2016 - 2030
63	Create official guidance for local and administrative general service agency (GSA) planning, designing, building and refurbishing industrial and city areas to make provision for equipment and systems that use RE in electricity and water heating	Administrative Procedures and Spatial Planning,	RE Generation Capacity increases	Rural and urban infrastructure providers, Population, End Users	Planned	2016 Onwards
64	Define national qualification schemes and standards for installers of RE equipment and the quality & standards of equipment	Certification of Installers for RE Equipment	Financial Support	Administration, operators, installers, investors, and developers of off-grid and mini-grid RE equipment, Investors, technical trainees, civil society	Investors and end users	Planned
65	Set up a system and a body for certifying installers to ensure high quality work during project implementation	Certification of Installers for RE Equipment	Financial	Generation Capacity Increased and active projects	Administrative Procedures and guideline developers	Planned

TABLE D: OVERVIEW OF MEASURES ON EFFICIENCY IMPROVEMENT, TECHNOLOGY EQUIPMENT, BIO-FUELS TECHNOLOGY, SOLAR TECHNOLOGY AND BASELINE DATA, ETC.

No.	Name of The Measure	Type of Measure*	Expected Results**	Target Group And/or Activity***	Existing or Planned	Start And End Dates of The Measure
66	Create official guidance for communities and areas to install off-grid equipment and systems that use RE in electricity and water heating	Guidelines for off-grids Electricity Network and generation development and Operation	Off-grid producers guidelines achieved	Rural and Peri-urban communities and RE developers	Planned	2016 - 2030
67	Promote the use of solar thermal energy for domestic and productive activities	Support Schemes to promote solar thermal	Solar thermal capacity in the homes	Residential sector, health centres, hotels, guest houses	Planned	2016 - 2030
68	Develop and implement a policy framework for the use and supply or biomass in the country.	Administrative	Generation Capacity and biomass projects in progress	Rural Population, biomass sector, End Users, Developers	Planned	2016 Onwards
69	Ensure harmonization of bio-fuels as well as other RE development and investment policies and strategies with other sector policies and strategies at the national level as well as with the regional bio-fuels strategy	Bio-fuels, Administrative Procedures and Regulatory	Developed harmonization policies on regulations, taxes, and support schemes proportional to the nature and resources	Public administration, investors, developers, IPPs	Planned	2016 onwards
70	Identify the national authority/body that is responsible for monitoring the compliance of the bio-fuels with sustainability criteria and for certification of bio-fuels	Bio-fuels Development	RE policy and regulatory mandates and clearly defined mandates and separation of powers	RREA, MLME, DOE, NERC and other players	Planned	2016 Onwards
71	Provide information on available land areas that can be used for the production of bio-fuels	Bio-fuels Production and sustainable resource base	Identified land and reserved areas for bio-fuel production	Land Commission, MOA, FDA NERC, RREA, MLME	Planned	2017 onwards
72	Promote the use of the biomass from agricultural and forestry/logging waste	Waste Disposal and Energy Production	Increased investments and development of	Developers, investors and regulatory authorities MFDP, MLME, RREA	planned	2016-2030

TABLE D: OVERVIEW OF MEASURES ON EFFICIENCY IMPROVEMENT, TECHNOLOGY EQUIPMENT, BIO-FUELS TECHNOLOGY, SOLAR TECHNOLOGY AND BASELINE DATA, ETC.

No.	Name of The Measure	Type of Measure*	Expected Results**	Target Group And/or Activity***	Existing or Planned	Start And End Dates of The Measure
	and invasive plant species to be used as a RE source of energy in articulation with the ECOWAS bio-energy program		technology			
73	Implement demonstration projects to show how to use agro-industry, forest logging and sawmills residues to produce energy	Waste Utilization and Energy Production	Biomass power generation plants, increased power capacity available	Sawmills, agriculture concessions, forestry logging operators	Planned	2016-2030
74	Improving the efficiency and sustainability of the energy value chain through participatory and sustainable forest management (PSFM)	Financial	Development of forest reserves, reforestation, and Improve FDA's capacity	Investors, developers, forest owners, wood industry	Planned	2016 - 2030
75	Promote the use of RES technologies in the water supply infrastructure and in the agro-food sector	Promote Nexus: Energy-Water-Food	Solar and RE Irrigation and water supply	Agriculture and water supply sector	Planned	2016 - 2030
76	Provide incentives for the utilization of national bio-fuels	Financial Support	Increased Investments	bio-fuels producers and consumers	Planned	2016 - onward
77	Identify the national authority/body that is responsible for monitoring the compliance of the bio-fuels with sustainability criteria and for certification of bio-fuels	Capacity building	Enabling environment	LERC, DOE,MLME, RREA	Planned	2016 - 2030
78	Provide information on the areas that can be used for the production of bio-fuels	Land administration	Public Information	Investors, developers	Planned	2016 - 2030
79	Ensure harmonization of bio-fuels policies and strategies with other sector policies and strategies at the	Studies	Enabling environment	Investors, developers, agriculture and forestry concessions and biomass energy	Planned	2016 - 2030

TABLE D: OVERVIEW OF MEASURES ON EFFICIENCY IMPROVEMENT, TECHNOLOGY EQUIPMENT, BIO-FUELS TECHNOLOGY, SOLAR TECHNOLOGY AND BASELINE DATA, ETC.						
No.	Name of The Measure	Type of Measure*	Expected Results**	Target Group And/or Activity***	Existing or Planned	Start And End Dates of The Measure
	national level as well as with the regional bio-fuels strategy			producers		
80	Promote the production of bio-fuel and make the necessary studies to analyse the national/regional supply of feed stock for expansion of the already existent unit	Policy measures	Database	Investors, developers, agriculture and forestry concessions and biomass energy producers	Planned	2016 - 2030
81	Promote biodiesel and ethanol substitution in transport sector	Regional Regulatory	Adaptation	Investors, developers, biodiesel fuel and equipment importers and energy producers	Planned	2016 - 2030

ANNEX II - DEFINITION OF TERMS USED IN THE NATIONAL RENEWABLE ENERGY ACTION PLAN

***Agrifuels**: Solid bio-fuels obtained from crops, and residues from crops and other agricultural products. Residues from agricultural production include animal solid excreta, meat and fish residues. Agrifuel is subdivided into bagasse, animal wastes and other biomass materials and residues (check definitions for bagasse, animal wastes and other agricultural residues).*

***Animal waste**: Excreta of animals which, when dry, are used directly as a fuel. This excludes waste used in anaerobic fermentation plants. Fuel gases from these plants are under biogases (see biogas).*

***Bagasse**: the fuel obtained from the fibre which remains after juice extraction in sugar processing*

***Bio-fuels**: liquid or gaseous fuel for transport produced from biomass.*

***Other vegetable material and residues**: bio-fuels not specified elsewhere and including straw, vegetable husks, ground nut shells, pruning brushwood, olive pomade and other wastes arising from maintenance, cropping and processing plants.*

***Solid bio-fuels:** solid fuels derived from biomass.*

***Liquid bio-fuels:** Liquids derived from biomass and generally used as fuels. Liquids bio-fuels comprise bio-gasoline, biodiesel and other liquid fuels (definitions of bio-gasoline, biodiesel and other liquid fuels are provided below).*

***Bio-gasoline**: Liquid fuels derived from biomass and used in spark-ignition internal combustion engines. Common examples are: bioethanol; biomethanol; bio ETBE (ethyl-tertio-butyl-ether); and bio MTBE (methyl-tertio-butyl-ether).*

***Biodiesel:** Liquid bio-fuels which are usually modified chemically so that they can be used as fuel in engines either directly or after blending with petroleum diesel. Biological sources of biodiesel include, but are not limited to, vegetable oils made from canola (rapeseed), soybeans, corn, oil palm, peanut, or sunflower. Some liquid bio-fuels (straight vegetable oils) may be used without chemical modification their use usually requires modification of the engine.*

***Biodiesel as a share of diesel and fuel-oil consumption (in %)**: The EREP sets conventional bio-fuels targets (1st Generation Bio-fuels) for the ECOWAS region as a whole, one of which is the biodiesel as a share of diesel and fuel oil consumption. In this template this is calculated by dividing the production of raw vegetal oil/biodiesel by the diesel oil/DDO/fuel oil consumption in the country.*

***Straight vegetable oil:** When vegetable oil is used directly as a fuel, in either modified or unmodified equipment, it is referred to as straight vegetable oil (SVO) or pure plant oil (PPO).*

***Other liquid bio-fuels**: liquid bio-fuels not elsewhere specified.*

***Biogas**: gases arising from anaerobic fermentation of biomass. These gases are composed principally of methane and carbon dioxide and comprise landfill gas, sewage sludge gas and other biogases (check definitions for landfill gas, sewage sludge gas and other biogases). They are used mainly as a fuel but can be used as a chemical feedstock. . It is particularly relevant for cooking purposes or in the context of industrial uses (e.g. breweries, slaughter houses).*

***Landfill gas:** biogas from anaerobic fermentation of organic matter in landfills.*

***Sewage sludge gas**: biogas from anaerobic fermentation of waste matter in sewage plants.*

***Other biogases**: biogases not elsewhere specified including synthesis gas produced from biomass.*

***Biomass**: biodegradable fraction of products, waste and residues from biological origin from agriculture (including vegetal and animal substances), forestry and related industries including fisheries and aquaculture, as well as the biodegradable fraction of industrial and municipal waste. The uses of biomass for energy are very diverse: from the traditional, low-efficiency burning of wood in open fires for cooking purposes to the more modern use of wood pellets for the production of power and heat, and the use of biodiesel and bioethanol as a substitute for oil-based products in transport.*

***Base Load**: Base load is the level below which electricity demand never drops, i.e. a site with a high maximum demand of 750 kVA whose demand never drops below 250 kVA would have a base load of 250 kVA. Large hydro power is an important renewable energy source for the provision of base load in the ECOWAS region. The significance will grow with the implementation of the WAPP hydropower project pipeline.*

***Charcoal**: The solid residue from the carbonisation of wood or other vegetal matter through pyrolysis. The amount of biomass (usually fuelwood) necessary to yield a given quantity of charcoal depends mostly on three factors:*

***Parent wood density** – the principal factor in determining the yield of charcoal from fuelwood is parent wood density, since the weight of charcoal can vary by a factor of 2 for equal volumes*

***Moisture content** - moisture content of the wood also has an appreciable effect on yields - the drier the wood, the greater is the yield - ; and*

***The means of charcoal production:** charcoal is produced in earth-covered pits, in oil drums, in brick or steel kilns and in retorts. The less sophisticated means of production generally involve loss of powdered charcoal (fines), incomplete carbonization of the fuelwood and combustion of part of the charcoal product, resulting in lower yields.*

***Traditional non-efficient charcoal production methods**: traditional charcoal production methods include open pits, oil drums and kilns with lower efficiencies. In the ECOWAS charcoal is mainly produced by traditional methods in the informal sector (e.g. open pits and kilns) which are inefficient (60-80% of the energy in the wood is lost) and has impacts on the health and on the environment.*

***Efficient charcoal production:** efficient charcoal is the terminology used on this template for the charcoal produced by modern methods that are more efficient than traditional ones. The modern methods use sealed containers and have higher efficiencies and thus higher yields. Within the EREP, under the targets for domestic cooking, a target for efficient charcoal production is set: 60%/100% of the charcoal production should be by improved carbonisation techniques (yield >25% in 2020 and 2030, respectively. In this template the MS is asked to set out its target and trajectory for efficient charcoal production. This is calculated by dividing the quantity of charcoal produced by improved carbonisation techniques with yield superior to 25% in tonnes by the total charcoal production in tonnes.*

***Conservation**: The reduction of energy usage through increased efficiency and/or reduced waste.*

***DDO**: Distillate Diesel Oil*

***Distributed and Microgeneration:** This is when electricity is generated for local distribution and is not connected directly to the national grid. Microgeneration is typically used to describe smaller scale generating technology.*

***Energy Efficiency appliances:** Electrical devices or appliances that perform their task, and use less electricity than lower-efficient devices. Electrical inefficiency in many devices is directly related to the heat they produce. For example, energy efficient light bulbs use most of the incoming electrical energy to produce light, not heat. Inefficient air conditioning is a major cause of peak hours in the ECOWAS region.*

***Electricity**: The transfer of energy through the physical phenomena involving electric charges and their effects when at rest and in motion. Electricity can be generated through different processes: e.g. by the conversion of*

energy contained in falling or streaming water, wind or waves or by the direct conversion of solar radiation through photovoltaic processes in semiconductor devices (solar cells); or by the combustion of fuels.

***Electricity demand**: The total electricity consumption in GWh or MWh consumed by a country annually. This includes the demand of the complete system including the incircuital consumption and the losses.*

***Electricity mix**: The range of energy sources of a region/country (either renewable or non-renewable) that is used to produce electricity,*

***Energy access**: A universal and affordable access to modern means of energy. It implies access to modern cooking solutions defined as relying primarily on non-solid fuels for cooking. It also implies access to electricity, defined as availability of an electricity connection at home or the use of electricity as the primary source of lighting that can provide non-served communities and households with a modern life and economic development.*

***Energy Efficiency**: the ratio of performance or output of performance of services, goods or energy to input of energy. The energy efficiency of a process is improved if it produces the same service using less energy. Energy-efficient light bulbs produce the same amount of light but use up to 75% less energy to do so. Improving energy efficiency helps reducing energy use or bringing more energy services with the same amount of energy consumed.*

***EREP:** ECOWAS Renewable Energy Policy*

***Ethanol**: also called ethyl alcohol, pure alcohol, grain alcohol or drinking alcohol, is a volatile, flammable, colourless liquid that can be used for several different purposes, being one of them as fuel. As fuel, ethanol is used as a motor fuel and fuel additive (e.g. Brazil relies in Ethanol as a motor fuel). Ethanol is also used for household heating as relatively safe fuels.*

***Ethanol as share of gasoline consumption:** The EREP sets first generation bio-fuels targets for the ECOWAS region as a whole, one of which is the ethanol as a share of the gasoline consumption. This is calculated by diving the quantity of ethanol produced by the quantity of gasoline consumed in the country and it is show in %.*

***Fossil Fuel:** An energy source formed in the Earth's crust from decayed organic material. The common fossil fuels are oil, diesel, coal, and natural gas. Some ECOWAS countries are highly dependent on diesel electricity generation.*

***Fuelwood, wood residues and by-products:** fuelwood or firewood (in log, brushwood, pellet or chip form) obtained from natural or managed forests or isolated trees. Also included are wood residues used as fuel and in which the original composition of wood is retained. In the ECOWAS region fuelwood is the principal source of energy for cooking and heating, however statistics on fuelwood are generally poor as it is mainly produced and traded in the informal sector.*

***Grid-connected:** a system (photovoltaic, hydro, diesel, etc.) that is connected to a centralised electrical power network (power grid).*

***Generation (electricity):** This covers the production of electricity at power stations.*

***Heat**: Heat is an energy carrier primarily used for warming spaces and industrial processes*

***Hybrid System:** a power system consisting of two or more power generating subsystems (e.g. combination of a wind turbine or diesel generator and a photovoltaic system)*

***Improved Cook-stoves (also called clean/efficient Cook-stoves):** is a device that is designed to consume less fuel and save cooking time, convenient in cooking process and creates smokeless environment in the kitchen or reduction in the volume of smoke produced during cooking against the traditional stove; and thus addressing he health and environmental impacts associated with traditional Cook-stoves.*

***Traditional Cook-stoves** (open fires and rudimentary Cook-stoves using solid fuels like wood, coal, crop residues and animal dung) are inefficient, unhealthy, and unsafe, and inhaling the acrid smoke and fine particles*

they emit leads lead to severe health problems and death. Traditional Cook-stoves also place pressure on ecosystems and forests and contribute to climate change through emissions of greenhouse gases and clack carbon.

Within the EREP targets are set for improved Cook-stoves, as the pressure on the ECOWAS woodland will grow exponentially. Thus the policy includes the banning of inefficient stoves after 2020, enabling 100% of the population of the urban areas to use high efficient wood and charcoal stoves (with efficiencies higher than 35%) from 2020 onwards and 100% of the rural population to use high efficient charcoal stoves from the same date on. In this template the MS is asked to set a target for improved Cook-stoves measured in terms of the % of the population that uses efficient Cook-stoves. This is estimated by dividing the number of inhabitants that use improved Cook-stoves by the total number of inhabitants of the country.

Installed capacity: *is the rated continuous load-carrying ability of a given electricity generation plant expressed in megawatts (MW) for active power*

- *Kilowatt (kW): 1,000 watts*
- *Kilowatt-hour (kWh): 1,000 watt-hours.*
- *LPG: Liquefied petroleum gas*
- *Load: In an electrical circuit, any device or appliance that uses power (such as light bulb or water pump)*
- *Megawatt (MW): 1,000,000 watts*
- *Megawatt-hour (MWh): 1,000,000 watt-hours*

Mini-grids*: set of electricity generators and, possibly, energy storage systems interconnected to a distribution network that supplies the entire electricity demand of a localized group of customers. This power delivery architecture can be contrasted with single customer systems (e.g. solar home systems) where there is no distribution network interconnecting customers, and with centralized grid systems, where electrical energy is transmitted over large distances from large central generators and local generators are generally not capable of meeting local demand. Mini-grids are particularly relevant in the rural context of ECOWAS where renewable energy powered hybrids can be the more cost-effective alternative. The EREP includes mini-grid targets.*

Modern fuel alternatives (for cooking): *known as non-conventional or advanced fuels, these are any materials or substances that can be used as fuels for cooking, other than conventional solid fuels such as coal, fuelwood and charcoal. These alternatives cover Liquefied petroleum gas (LPG), biogas, ethanol, solar power (e.g. solar cookers) and kerosene. In this template improved Cook-stoves are not considered within the modern fuel alternatives, as they are object of a separate analysis in this template.*

Non-technical losses: *in electricity distribution include mainly electricity theft, but also losses due to poor equipment maintenance, calculation errors and accounting mistakes. Non-Technical losses are caused by actions external to the power system or are caused by loads and condition that the Technical losses computation failed to take into account. Non- Technical losses are more difficult to measure because these losses are often unaccounted for by the system operators and thus have no recorded information. A reduction of the losses can contribute considerably to the improvement of energy security in many ECOWAS countries.*

Offshore wind: *wind projects installed in waters off the coast.*

Onshore wind: *Wind farms installed on land.*

Operating costs: *the costs of using a system; for fuel-based systems these costs include all fuel costs over system lifetime;*

Off-grid applications: *is a designation for facilities that produce all their own energy and are not connected to any external source, such as the electrical power grid.*

Peak Load: maximum value of necessary capacity to face peak demand. In terms of this template, peak load is characterised for a given year in MW (this includes the load of the complete system including the in circuital consumption and the losses).

Photovoltaic (PV) system: *a complete set of interconnected components for converting sunlight into electricity by photovoltaic process, including array, balance-of-system components, and the load.*

Power grid*: a system of high-tension cables by which electrical power is distributed throughout a region*

Renewable Energy (RE): *'Renewable energy' is used to describe the energy produced using naturally replenishing resources. This includes solar power, wind, geothermal, bio-energy, wave and tide and hydropower.*

Renewable energy sources *– in this template the renewable energy sources refer to the following renewable energy technologies:*

Hydropower which includes:

1. *Small scale hydropower (small-hydro or SSHP) up to a maximum installed capacity of 30 MW;*
2. *Medium (capacity between 30MW and 100MW) and large hydropower (capacity higher than 100MW);*

In the EREP hydropower is defined as follows: up to 30 MW small-scale, 30 to 100 MW medium-scale, more than 100 MW large-scale.

Bio-Energy Covering Three Different Fields:

Woodfuels *(firewood and charcoal) used for domestic cooking purposes and commercial applications (restaurants, breweries, potteries, blacksmiths, brick makers). Excess woodfuels resources could be used for power generation with other biomass.*

By-products from crops production for power generation (stalks, straw, husks, shells, kernels, etc.): *These can serve as fuel for power generation when gathered together on an agro-industry site. Power can also be generated through biogas production using industrial or urban waste, manure and dung (resource concentration at dairies or slaughter houses or cattle and vegetable markets).*

Energy crops for power generation or sustainable bio-fuels *(e.g. jatropha) offer some interesting perspectives. EREP considers 2nd generation bio-fuels which do not compete with food crops for available land, and comply with the following minimum criteria; lifecycle GHG reductions, including land use change and social standards.*

Wind energy *(on-grid and off-grid applications);*

Solar*: PV, Concentrated Solar Power (CSP) and solar thermal water heating.*

Tide, wave and ocean and geothermal, *although not considered in the EREP as renewable energy options, were included on the template as some of the countries have available potential for its use for generation of energy.*

Geothermal: *Geothermal energy can provide low-carbon base-load power, heat (and cooling) from high-temperature hydrothermal resources, deep aquifer systems with low and medium temperatures, and hot rock resources.*

Renewable energy share in the electricity mix: - *is the share of renewable energy electricity generation in the total electricity generation for a given year, measured in %. This is calculated in the template by dividing the electricity production from renewable energy sources (in MWh/year) by the total electricity production (in MWh/year) – renewable and non-renewable for the same year.*

***Rural Electrification**: Provides a regular supply of electricity to rural residents. It implies the extension of power lines to rural areas, or the use of stand-alone, mini-grids or isolated power systems. The EREP includes targets for rural electrification.*

***Rural Population as referred for off-grid applications (mini-grids and stand-alone systems):** Following EREP's definitions, it refers to the population for which the mini-grid and decentralised supply systems apply.*

Share of rural population served with off-grid (mini-grids and stand-alone) renewable energy electricity services: this is the percentage (%) of the rural population as defined above that is served with mini-grids and stand-alone system. This is calculated by dividing the number of inhabitants served by off-grid applications by the number of rural inhabitants (as defined above).

***Rural communities**: These includes population living in rural centres and villages with population between 200 and 2,500 inhabitants and some larger cities that due to its peripheral geographical location are away from the national grid. The EREP refers as well that some of the off-grid rural localities supplied before 2020 might be included in the grid extension as they will potentially grow up.*

***Solar cookers**: or solar oven, is a device which uses the energy of direct sun rays (which is the heat from the sun) to heat, cook or pasteurize food or drink.*

***Solar thermal water heating:** or solar hot water (SHW) systems comprise several innovations and many mature renewable energy technologies that have been well established for many years. In these systems water is heated by the sun using collectors. These systems are designed to deliver hot water for most of the year. They can contribute to the reduction of peak hours in the urban context. Moreover, they can be an effective tool to save energy costs in hotels, hospitals and industrial processes (e.g. beverage industry)*

***Stand–alone power systems (SAPS)**: also known as remote area power supply, is an off-the-grid electricity system for locations that are not fitted with an electricity distribution system. Typical SAPS include one or more methods of electricity generation, energy storage, and regulation.*

***Support scheme:** means any instrument, scheme or mechanism applied by a Country or group of Countries, that promotes the use of energy from renewable sources by reducing the cost of that energy, increasing the price at which it can be sold, or increasing, by means of a renewable energy obligation or otherwise, the volume of such energy purchased. This includes, but is not restricted to, investment aid, tax exemptions or reductions, tax refunds, renewable energy obligation support schemes including those using green certificates, and direct price support schemes including feed-in tariffs and premium payments.*

Some Support Schemes for Renewable Energy:

Production Based Incentives:

***Feed-in-Tariff ("FIT"):** is an energy supply policy that promotes the deployment of renewable energy resources. A FIT offers a guarantee of payments to renewable energy producers for the actual electricity produced ($/kWh). These payments are generally awarded as long-term contracts.*

Investment Based Incentives

***Capital grants and loans:** investment instruments in which government provide grants or loans for the development of renewable energy projects. Grants do not have to be repaid, while loans have to be repaid.*

***Microcredits:** is the extension of very small loans (microloans) to impoverished borrowers who typically lack collateral, steady employment and a verifiable credit history.*

***VAT Exemptions:** allows households or investors not to have to pay VAT on renewable energy or energy efficiency equipment*

Tidal And Wave (marine generation): *The principle behind tidal generation is similar to wind turbines, except that instead of wind turning the turbine blades, the process uses underwater current caused by tides. One of the benefits of tidal power over wind power is the predictability of tidal currents, enabling the developers to know exactly when the turbines will be producing power. Electricity can also be generated by harnessing the energy waves. The aim is to capture the vertical movement in the water surface caused by waves and to convert that energy to electricity by turning a generator.*

Technical losses: *Losses in power system that are caused by the physical properties of the components of the power system. Technical losses are naturally occurring losses (caused by action internal to the power system) and consist mainly of power dissipation in electrical system component such as transmission lines, power transformers, measurement system, etc.*

Watt-hour (Wh): *a measure of electric energy equal to the electrical power multiplied by the length of time (hours) the power is applied.*

Waste: *in energy statistics waste refers to the part of the waste that is incinerated with heat recovery at installations designed for mixed wastes or co-fired with other fuels. The heat may be used for heating or electricity generation. Certain wastes are mixtures of materials of fossil and biomass origin.*

Industrial waste: *non-renewable waste which is combusted with heat recovery in plants other than those used for the incineration of municipal waste. Examples are used tires, specific residues from the chemical industry and hazardous wastes from health care. Combustion includes co-firing with other fuels. The renewable portions of industrial waste combusted with heat recovery are classified according to the bio-fuels which best describe them.*

Municipal waste: *Household waste and waste from companies and public services that resembles household waste and which is collected at installations specifically designed for the disposal of mixed wastes with recovery of combustible liquids, gases or heat. Municipal wastes can be divided into renewable and non-renewable fractions.*

Wind power: *The conversion of energy in the wind into electrical power using a wind turbine. Wind farms can be sited on land or at sea, with those offshore able to take advantage of the much stronger and consistent winds found off the coast.*

ANNEX III – REGIONAL INITIATIVES IN RENEWABLE ENERGY

The ECOWAS White Paper on Increasing Access to Energy Services in Peri-Urban and Rural Areas by 2015

The ECOWAS White Paper was adopted in 2006 by the ECOWAS Heads of States and Government in recognition of the key role that energy plays in the achievement of the Millennium Development Goals (MDGs). The White Paper aims to provide access to improved domestic cooking fuels and sustainable electricity services for the majority of the population by 2015. Moreover, it foresees that at least 20% of new investments in electricity generation should originate from locally available renewable resources, in order to achieve self-sufficiency, reduced vulnerability and sustainable environmental development.

The ECOWAS Energy Protocol

The ECOWAS Energy Protocol is a legal text that formalises the juridical framework of enterprises in the energy sector that was modelled after the European Energy Charter Treaty. It promotes investment and trade by serving as a security for foreign direct investments in the energy sector. The ECOWAS Member States have completed the process of ratifying the Protocol which aims to provide a legal and regulatory framework for all regional energy integration initiatives and projects. In this view, Liberia recognizes and incorporates the ECOWAS Energy Protocol as a part of its NREAP.

The ECOWAS Bio-energy Strategy Framework

The ECOWAS Bio-energy Strategy Framework, adopted by the ECOWAS Council of Ministers in June 2013, aims to enhance the sustainable Bio-energy production and use within the Region that help address energy poverty, particularly in the rural and peri-urban populations, promotes food security, safeguard the environment, and enabling domestic and foreign investments. Development of National Action Plans should take into consideration the following objectives and initiatives:

1. Universal access to modern energy services, especially in the rural and peri-urban areas by 2030;
2. A more sustainable and safe provision of domestic energy services for cooking thus achieving the objectives of the White Paper for access to modern energy services by 2020 and Increasing food security within the region;
3. Promote the transition from the traditional use of biomass towards a modern, efficient production and use of modern Bio-energy;
4. Broaden regional dialogue and peer-to-peer learning to support the development of Bio-energy strategies in the ECOWAS Member States ;
5. Promote regional policy planning for Bio-energy harmonized with national policies;
6. Sensitize and share experiences on modern sustainable Bio-energy production that also promotes food security; and
7. Create a vibrant and sustainable modern Bio-energy sector that promotes economic growth, rural development, and poverty alleviation.

The ECOWAS Small-Scale Hydropower Program (SSHP)

THE ECOWAS Small-Scale Hydropower Program, adopted by the ECOWAS Council of Ministers in June 2013, aims to contribute towards increased access to modern, affordable and reliable energy services by establishing an enabling environment for small-scale hydro power investments and markets in the ECOWAS region. It is a part ot the NREAP of Liberia to undertake programs and activities in accordance with the ECOWAS SSHP.

Between 2013 and 2018 the following specific program objectives will be achieved:

1. At least six ECOWAS countries will have improved their legal framework (poverty reduction impact of SSHP evidence in their legal framework, feed-in tariff defined, transparent licensing procedure etc.);

2. ECOWAS Member States integrate SSHP into their scenarios, planning documents and budgetary allocations;
3. National SSHP initiatives and projects increasingly rely on local expertise from public and private sector (with limited international support) – at least 1000 experts are trained;
4. Quality guidelines are in use and quality of SSHP project proposals and feasibility studies improved;
5. SHPP, planning tools and all other SHPP related publications are available on the ECREEE website;
6. A least 35 additional SSHP projects per year are developed up to feasibility study level. The construction of 50 projects has commenced. The more funding is mobilized the more projects can be developed;
7. At least 10 companies established to provide various SSHP related services (planning, operation, repair etc.);
8. Sustainability criteria and biodiversity offsetting will be mainstreamed throughout the planning and construction of SHP plants.

ECREEE Rural Electrification Program (ERuEP)

The implementation of ERuEP will be done based on the four main pillars of ECREEE work programs:

1. Policy Support (P);
2. Capacity Development (C);
3. Project Development and Financing (D); and
4. Knowledge Management (K).

These four pillars are vastly interlinked, and their importance for program development in ECREEE is that, it allows for planning to take into account all the aspects needed for a successful implementation. A feasible initiative must include policy mechanisms, capacity building initiatives; promote the development and financing of specific projects and appropriate knowledge management, starting with awareness raising and knowledge sharing.

The main activities to be undertaken in the rural electrification initiative include:

- Support Member States in setting up the enabling environment and institutional framework for Mini-grids.
- Support MS in analysis and planning of rural electrification through GIS based rural electrification planning
- Support the identification of national tailored approach to rural electrification
- Support the establishment of appropriate institutional and legislative framework
- Promote an enabling environment for private sector involvement
- Promote regional policy on rural electrification
- Strengthen the capacities on sustainable management, operation and maintenance of existing systems
- Technical and entrepreneurial training to build capacity on local manufacturing of components
- Mentorship to entrepreneurs
- Support project preparatory activities
- Support governments in fund mobilisation
- Direct support to implementation through EREF calls

The ECOWAS Program on Gender Mainstreaming in Energy Access (ECOW-GEN)

The ECOWAS Program on Gender Mainstreaming in Energy Access (ECOW-GEN) was established against the background that women's potential, in the ECOWAS region, as producers and suppliers of energy services is under-utilized and that empowering women to make significant contributions in the implementation of the adopted regional renewable energy and energy efficiency policies is necessary for the achievement of the Sustainable Energy for All (SE4ALL) goals in West Africa. Moreover, the program is founded upon the principles of the ECOWAS Gender Policy which emphasizes the "need to develop policies and programs to provide alternative energy sources which would contribute to women's health and also alleviate their time burden".

To stimulate the development of women-led business initiatives in the energy sector, ECREEE, through the support of the Spanish Agency for International Cooperation and Development (AECID), established the ECOWAS Women's Business Fund. ECREEE will work with Member States to identify and support, through the fund, innovative energy projects implemented by women groups and associations. In addition to this, ECREEE will assist Member States to establish similar funds in their respective

The ECOWAS Solar Thermal Program

The overall goal of the Solar Thermal Program (SOLTRAIN) in West Africa is to contribute to the switch from a fossil fuel based energy supply to a sustainable energy supply system based on renewable energies in general but based on solar thermal in particular. The overall project will be coordinated by ECREEE and technically implemented by AEE INTEC in cooperation with 8 institutional project partners from 7 West African countries (Cape Verde, Nigeria, Burkina Faso, Ghana, Mali, Senegal, Niger and Sierra Leone).

The ECOWAS solar thermal capacity building and demonstration program therefore aims to remove existing awareness, political, technological, and capacity related barriers which restrict solar thermal energy deployment in ECOWAS countries. The program will also contribute to increase the grid stability and save national power reserves as solar thermal systems will significantly reduce the stress on electric grids due to the shift from electricity to solar energy. The program links precisely to the goals of the regional polices on Renewable energy and energy Efficiency adopted by the ECOWAS Authority of Heads of State and Government in 2013. The regional policies considered solar thermal as a least cost sustainable energy technology and set specific targets for its use to meet sanitary and industrial hot water needs in the region.

The Goals of SOLtrain West Africa are:

Capacity Building by theoretical and practical Train-the-trainer courses to selected universities and polytechnic schools in the area of solar water heating and solar thermal drying
Identify, monitor, analyze and improve existing solar thermal systems together with the partner institutions (practical training).

Technical support of local producers:

Design and Install solar thermal systems for the partner institutions for teaching and demonstration purposes;
The partner institutions will offer trainings to national companies, installers, producers and further training institutions within their countries.

Installation of 200 Demonstration systems at social institutions as schools and hospitals engineered by the partner institutions and installed by national practitioners
Trainings to administrative, political and financial stakeholders in each country
Solar thermal testing facility in one of the countries

The ECOWAS GENERATION AND TRANSMISSION MASTER PLAN

The ECOWAS Renewable Energy Policy highlights renewable energy scenario that is fully complementary to the ECOWAS power supply strategy and conventional national supplies, both as a significant contribution to bulk power generation and as a prevailing contribution to universal energy access for rural areas. Projects to be developed under the renewable energy power generation are to be implemented by ECREEE.
The ECOWAS Generation and Transmission Master plan approved in September 2011, foresees 30 power generation projects selected as regional priority power projects with a total capacity of 10.3 GW and a cost of US$18 billion (€15 Billion). The major share of this new generation and transmission capacities is projected to be available from 2017 to 2019. The selected projects are based primarily on large hydro power (21) with 7,093 MW, on natural gas (3) with 1,300 MW, on coal (2) with 1,075 MW and on renewable energy (4) with 800 MW. It must be noted that some projects are already getting delayed, and, therefore, the proposed scenario will most likely not happen as scheduled. This would have serious consequences for the importing countries and countries relying on new large hydro. In this context, RE technologies might assume more competitive roles.

The tables below show the lists of projects (generation and transmission) earmarked for regional implementation or as regional priority projects:

Table 1: REGIONAL PRIORITY GENERATION PROJECTS

Regional Project	Priority Capacity	Annual Energy Generation	Generation Cost	Year of Project Commissioning
Coal Power plant in Sendou-(**Senegal)**	875MW		US$ 2532 Million	2016
Gouina Hydroelectric Project: Interconnecting Kayes **(Mali)-**Tambacounda **(Senegal)**	140 MW	565GWh	$329 Million	2017
Wind Farm(Senegal-the Gambia)	200 MW		$318 Million	2021
Hydroelectric plants of Boureya (OMVS) – Badoumbé (OMVS) – Balassa (OMVS) and Koukoutamba (OMVS) 1. Badoumbé 2. Balassa	70 MW	410GWh	$197 Million	2017-2019
3. Boureya	181 MW	401GWh	$171 Million	2017-2019
4. Koukoutamba	160 MW	455GWh	$373 Million	2021
(Mali)	281 MW	455GWh	$404 Million	2019-2021
Kaléta Hydro **(Guinea**)	240 MW- 3 x 80 MW	946GWh	267 Million $	2015
Sambangalou Hydro (**Guinea**)	128 MW- 4 x 32 MW	402GWh	433 Million $	2017
Digan Hydro (**Guinea**)	93.3 MW	243GWh	112 Million $	2012
Souapiti Hydro (**Guinea**)	515 MW	2518GWh	796 Million $	2017-2019
Amaria Hydro(**Guinea**)	300MW	1435GWh	377 Million $	2019-2021
Grand Kinkon Hydro (**Guinea**)	291MW	720GWh	298 Million $	2012
Kassa Hydro (Guinea/Sierra Leone)	135 MW	528GWh	214 Million $	2019-2021
Mount Coffee Hydro	66 MW	435GWh	383 Million $	2015

Table 1: REGIONAL PRIORITY GENERATION PROJECTS

Regional Project	Priority Capacity	Annual Energy Generation	Generation Cost	Year of Project Commissioning
(**Liberia**)				
Bumbuna Hydro(**Sierra Leone**)	400 MW – 1,560GWh – 520M$	1,560GWh	520 Million $	2017-2019
Félou Hydro **(Mali)**	60 MW	350GWh	170 Million $	2013
Solar project 150 MW **(Mali)**	150MW - $549M		549 Million $	2019-2021
Tiboto Hydro (Cote d'Ivoire)	225 MW	912GWh	578 Million $	2021
Fomi Hydro (**(Guinea)**	90 MW	374GWh	156 Million $	2017-2029
Soubré Hydro (Côte d'Ivoire)	270MW	1,120GWh	620 Million $	
Aboadze- combined cycle Thermal Plant (Ghana)	400 MW		356 Million $	2014
Hydro Adjaralla (Togo)	147 MW	366GWh	333 Million $	2017
Project of combined cycle Thermal (**Togo)**	450 MW		401 Million $	2021
Project of thermal plant in Maria Gleta **(Benin)**	450 MW		401 Million $	2014
Solar project 150 MW **(Burkina Faso)**	150MW		549 Million $	2017-2019
Mambilla Hydro (Nigeria)	2600MW	1,1214GWh	$4000 Million	2019-2021
Zungeru Hydro **(Nigeria)**	700 MW	3019GWh	1,077Million $	2017-2019
Wind Farm 300 MW **(Nigeria)**	300 MW		477 Million $	2021
Coal plant of Salkadamna **(Niger)**	200 MW		573 Million $	

TABLE 2: REGIONAL PRIORITY TRANSMISSION AND INTERCONNECTION PROJECTS			
Project	**Length of Transmission Line**	**Cost of Project**	**Commissioning Year**
Hydroelectric plant Gouina: 225 kV OMVG loop	280 km	$65 Million	2019
225kV OM VG double circuit loop Linsan (Guinea) -Manantali **(Mali)** Reinforcement of Manantali-Bamako-Sikasso (**Mali**) section		$131 Million $151 Million	1st circuit: 2017-2019; 2nd circuit: 2019-2021
225kV OM VG loop Bolgatanga (**Ghana**) – Bobo Diolasso (**Burkina**)- Bamako (**Mali**)	742 Km	230 Million $	2015
225 kV OMVG loop between Senegal, The Gambia, Guinea-Bissau.	1677 Km	576.5 Million $	2017
Grand Kinkon western section of OMVG loop		141 Million $	2012
CLSG 225kV OMVG double circuit loop.	1060 km	430 Million $	2015
Second circuit of CLSG line 225kV OMVG loop	1060	69 Million $	2017-2019
225kV OMVG loop Ségou (**Mali**) - Ferkessédougou (**Ivory Coast**)	370 km	175 Million $	2012
225kV OMVG loop Buchanan (**Libéria**) – San Pedro (**Ivory Coast**)	400 km	$100 Million	2019-2021
225kV OMVG loop Linsan-Fomi – Fomi-Nzerekoré – Fomi-Bamako	1350 km	550 Million $	2017-2029
225kV OMVG double circuit loop Fomi (**Guinea**) –Boundiali (**Ivory Coast**)	380 km	111 Million $	2019-2021
225kV OMVG loop Soubré- Taabo (**Ivory Coast**)	196 km	69 Million $	2017-2019
225kV OMVG loop Bolgatanga (**Ghana**) – Ouagadougou (**Burkina Faso**)	206 km	74 Million $	2013
330kV OMVG loop between **Prestea** and **Bolgatanga** (**Ghana)**	640 km	240 Million $	2017-2019
330 kV OMVG loop Niamey (**Niger**) - Birnin Kebbi (**Nigeria**) - Malanville (**Benin**) – Ouagadougou (**Burkina Faso**)	832 km	540 Million $	2017-2019
760 kV OMVG loop network through **Nigeria**	2700 km	2000 Million $	2019-2021

TABLE 2: REGIONAL PRIORITY TRANSMISSION AND INTERCONNECTION PROJECTS			
Project	**Length of Transmission Line**	**Cost of Project**	**Commissioning Year**
Median Backbone 330kV OMVG loop	713 km	238 Million $	2019-2021
330 kV OMVG double circuit loop Sakete (**Benin**) - Omotosho (**Nigeria**)	120 km	39 Million $	2021
225kV OMVG loop Salkadamna-Niamey (**Niger**)	190 km	72 Million $	2019-2021

ECOWAS-ACTION PLAN IMPLEMENTATION STRATEGIES AND STATUS

Regional Priority Projects planned for implementation **2011 – 2025:**
10 000 MW to be installed of which **7 000 MW** will be hydro sources
16 000 km of transmission lines
TOTAL INVESTMENT COST is **US$ 24 BILLION** with GENERATION COST of **US$ 18 BILLION** AND TRANSMISSION of **US$6BN**

TABLE 3: STATUS OF IMPLEMENTATION OF ECOWAS TRANSMISSION PROJECTS		
Project	Status of implementation	Time of Commissioning
330 kV Riviera (Cote d'Ivoire) – Prestea (Ghana	Projects on-going	Expected commissioning 2015
330 kV Aboadze (Ghana) – Volta (Ghana)	Operational since 2010	Completed
330 kV Volta (Ghana) – Lome "C" (Togo) – Sakete (Benin)	Under-implementation	Completed
330 kV PHCN/TCN **(Nigeria)**	At level of preparation	Expected to be completed 2017
330 kV ABOADZE – PRESTEA – KUMASI – BOLGATANGA , Tumu – Han – Wa	At level of pre-investment	Expected to be completed 2015
Han (Ghana) – Bobo Dioulasso (Burkina Faso) –Sikasso (Mali)– Bamako (Mali)	Pre-investment	Expected to be completed 2015
225 kV Nzerekore (Guinea) - Fomi (Guinea) – Bamako (Mali)	Pre-investment	To be completed 2016
330 kV Birnin Kebbi (Nigeria) - Bemberke (Benin) – Niamey (Niger) Ouagadougou (Burkina Faso)	Pre-investment	To be completed 2017
147 MW WAPP Adjarala Hydropower Facility	Pre-investment	To be completed 2017

TABLE 3: STATUS OF IMPLEMENTATION OF ECOWAS TRANSMISSION PROJECTS		
Project	Status of implementation	Time of Commissioning
60 MW Felou Hydropower Project	At level of implementation	To be completed 2014

INTER-ZONAL TRANSMISSION HUB SUB-PROGRAM

(Burkina Faso, OMVS via Mali, Cote d'Ivoire via Mali, CLSG via Cote d'Ivoire).
The main transmission hub sub-programs for the region include:
225 kV Bobo Dioulasso (Burkina Faso) – Ouagadougou (Burkina Faso);
225 kV Bolgatanga (Ghana) – Ouagadougou (Burkina Faso);
225 kV Cote d'Ivoire – Mali;
330 kV Aboadze (Ghana) – Prestea (Ghana) – Kumasi (Ghana) – Bolgatanga (Ghana) + Tumu (Ghana) – Han (Ghana) – Wa (Ghana);
Han (Ghana) – Bobo Dioulasso (Burkina Faso) – Sikasso (Mali) – Bamako (Mali);
225 kV Fomi (Guinea) – Bamako (Mali) – Nzerekore (Guinea) – Linsan (Guinea)
147 MW WAPP Adjarala Hydro Power Facility

Both the generation and transmission projects identified under the ECOWAS Generation and Transmission Master Plan have been spread between phases 1, 2 and 3 according to:
The implementation of this master plan has been scheduled to ensure the load supply throughout the region. This will be implemented in line with following phases of development:
Phase 1: Commissioning in the period 2017-2019
Phase 2: Commissioning between 2019 and 2021
Phase 3: Commissioning at long-term (2021-2023)

THE WEST AFRICA GAS PIPELINE (WAGP)

The West African Gas Pipeline project is an International Gas transmission system that will transport clean, reliable and cheap natural gas from Nigeria to customers in Benin, Togo and Ghana. The proposal for a natural Gas Pipeline across West Africa was made in 1982 by the ECOWAS Commission ECOWAS as a key regional economic goal. The World Bank undertook a study on this in 1992 which confirmed the viability of a Natural Gas Pipeline based on ample reserves of Nigerian Natural Gas and Regional Energy needs. The plan calls for Chevron and its partners to build a 620-mile offshore line capable of initially shipping 180 million cubic feet of Nigerian gas per day for sale to power plants and other major gas users in Ghana, Togo and Benin.
The main objectives of the gas pipeline master plan were three folds:

To encourage Royal Dutch Shell and Chevron to tap into a vast resource that since the onset of oil production in the 1960s has been wasted in the associated gas burning-off process known as flaring.
To provide a cheap source of energy in a region starved of electricity, by serving as International Gas Transmission System that will transport clean, reliable and cheap natural gas from Nigeria to customers in Benin, Togo and Ghana.

Foster regional economic and political integration that would support economic growth, and in particular the development of the West Africa electricity market

Agreement on project
In 2000, the four nations involved signed an Intergovernmental Agreement for a harmonized fiscal and regulatory framework for cross-border construction and operation of the gas pipeline. The four Nations and the West African Pipeline Company (WAPCo) signed International Project Agreement (IPA) for the development of the pipeline in

2003. Construction of the WAGP therefore began in 2005 and by 2008, the Pipeline construction had completed and gas introduced into pipeline.

The Project benefit

The project is the sub-region's solution to bringing energy for economic growth and environmental benefits to Ghana, Togo, Benin and Nigeria. To help in the energy access challenges in the sub-region, the WAGP aims to achieve the following benefits:

- Provide a long-term supply of abundant, clean, relatively cheaper fuel from Nigeria to Ghana, Togo and Benin;
- Transfer technical knowledge and skills to relevant public agencies, local consultants, contractors and their employees across the four countries
- Employ over 100 skilled people from the sub-region, on competitive selection basis. This number has been far greater during construction
- Provide a new level of regional co-operation and economic integration to enhance regional stability under the auspices of ECOWAS
- Serve as a catalyst for direct foreign investment in the project countries
- Provide Nigerian producers with benefit from additional revenues accruing from the sale of associated gas to WAPCo

APPENDIX IV GIVES THE CALCULATION PARAMETERS FOR THE SCENARIOS NREAP-NEEAP-SE4ALL

Appendix III Gives the Calculation Parameters for the Scenarios for NREAP-NEEAP-SE4ALL. Calculation Parameters for the Scenarios NREAP - NEEAP -SE4ALL		
	Value	
Base year	2010	To be chosen by the national team, on the basis of availability of data
Beginning of execution of national plans	2016	Year in which the execution of the NREAP, NEEAP and SE4ALL plans will start
General parameters (data for the base year)		
Country: Liberia	Liberia	
Population	3,630,030	
Population growth rate	2.0%	
Family size	5	Number of people per housing unit
National currency (Liberian Dollar)	LD$	
Exchange rate (LD$/US$1)	80	= value euro/value national currency
GDP (000 000)	1,946	in millions, of national currency
Annual economic growth rate	5.5%	in %

National discount rate	10.0%	This is equivalent to the interest rate used to calculate the profitability of investments. It is used in this tool to calculate net present values of energy investments. If no national value is available (for instance from the Ministry of Economy), use a suggested value =10%)
Parameters and objectives for the power sector		
Installed generation capacity (MW)	65	It would be preferable to exclude capacity that has been out of service for a long period of time, for instance > 2 years
Annual electricity generation (GWh)	190	
Growth rate of electricity generation	17.1%	
Electricity tariff (Liberian Dollar/per kWh)	43.20	
Expenses for purchase of fossil fuels, as percentage of total power sector costs	50.0%	Expenditures on fossil fuels for thermal electricity generation, divided by the total value of sales of electricity from thermal sources
GHG intensity of the electricity sector (kg/MWh)	400	Average Greenhouse Gas (GHG) emissions of the electricity sector, in kg CO2 equivalent per MWh electricity produced
Parameters and objectives for rural electrification and access to electricity		
Rate of access to electricity (base year)	1.4%	
Target year to reach universal access	2030	According to national objectives and plans, including the national SE4ALL Action Agenda
% of grid connections	60.0%	Percentage of households connected to the national grid (acc. to national plans and objectives); this does not include user that will receive service from mini-grids or stand-alone systems
Cost of grid connection (Liberian Dollar)	24,000	Average costs of connecting a new user to the grid (including costs born by the utility and costs born by the user)
Cost of off-grid service (Liberian Dollar)	24,000	Average costs per user of mini-grids or stand-alone systems
Economic impact of access to electricity (Liberian Dollar)	4,800	Increase in GDP attributable to each new household receiving access to electricity (both grid connected and off-grid solutions)
Parameters and objectives for the use of renewable energy in the power sector		
PV generation (in the base year) (GWh)	0	

Technical and economic potential for new PV generation (MW)	253	Taking into account all local conditions (favorable/unfavorable): cost of alternative fossil based technologies; willingness and ability to pay of users; local technical capacity; availability of public and private capital, etc.
Number of operating hours of PV per year (Hours)	1,800	Number of hours of generation/year; calculated as an equivalent to the numbers of hours at full capacity generation
Investment cost per kW PV (Liberian Dollar)	200,000	
Average annual operating costs per MW of installed PV capacity (Liberian Dollar)	2,332,800	
Wind generation (base year) (GWh)	0	
Technical and economic potential for new wind generation (MW)	0	same as PV
Number of operating hours of wind per year (hours)	2,500	same as PV
Investment cost per kW wind (Liberian Dollar)	160,000	
Average annual operating costs per MW of installed wind capacity (Liberian Dollar)	6,480,000	
Hydropower generation (base year) (GWh)	40	
Technical and economic potential for new hydropower generation (MW)	175	same as PV
Number of operating hours of hydropower per year (hours)	4,500	same as PV
Investment cost per MW of hydropower (Liberian Dollar)	240,000	
Average annual operating costs per MW of installed hydropower capacity (Liberian Dollar)	3,888,000	
Year to realise the full RES potential	2025	According to national plans and objectives, year in which the combined planned new RES investments will be operational
Parameters and objectives for energy efficiency in the power grid		
Rate of grid losses (base year)	28.0%	Technical and non-technical losses in electricity transmission and distribution
Year in which losses will be reduced to 10%	2025	According to applicable power sector plans and the NEEAP; as defined in the NEEAP, the year in which the losses of the electric grid will be reduced to 10% of electricity generation

Capital intensity of grid EE investments (Liberian Dollar)	80,000	Value of investment (hard, soft, institutional) needed to reduce losses by 1 MWh/year, expressed in the national currency
Parameters and objectives for EE in grid connected domestic lighting		
Number of lights per grid connected household	9	= national average
Power rating of incandescent lamps (W)	60	= national average
Year to attain 100% high efficiency lighting	2018	Year in which all incandescent lamps shall be replaced by high efficiency lamps (CFL, LED, etc.); the period for execution of the "EE lighting plan" should be less than the average lifetime of high efficiency lamps
Cost of one low consumption lamp (LCL) (Liberian Dollar)	160	Average cost, including all types of high efficiency lamps
Lifetime of LCL (years)	4	Average lifetime, including all types of high efficiency lamps
Verification of the length of the plan	Plan OK	Automatic verification, carried out by the tool!
Number of use hours/year/lamp (hours)	1,200	= national average
Estimated total national power consumption for household lights (GWh)	7	Automatic calculation based on the parameters above. This should amount to approx. 50% of total national power use for all types of lighting (see automatic verification below)
National total power consumption for lighting (independent data) (GWh)	22	Independent household data of all types, obtained e.g. from national power company, national statistics organization, etc.
Automatic verification of lighting data	Data OK	
Reduction of electricity consumption through the use of high efficiency lamps	60%	Estimated reduction in household power consumption through the implementation of a national program to disseminate high efficiency household lighting
Parameters and objectives for EE off-grid lighting		
Number of off-grid lights per household	3	= national average, number of lights and lighting devices per family, including stand-alone solar lamps or high-efficiency lamps powered by a decentralized or stand-alone source (solar PV, pico-hydro, mini-grids, etc.)
Fossil fuel consumption for lighting per family per year (kg)	30	Average consumption per household of fossil fuels - such as kerosene, oil, etc. - for lighting and other energetic uses
Price of kerosene (per liter) (Liberian Dollar)	120	

Cost of an off-grid lighting device (Liberian Dollar)	1,600	National average cost of off-grid lighting devices for all types of technologies: stand-alone solar lamps, the lighting portion of a solar home system etc.
Lifetime of an off-grid lighting device (years)	3	
Parameters and objectives for EE in buildings		
Percentage of national electricity consumption in buildings (in base year)	40%	For air conditioning, ventilation, water heating; this does not include lighting
Technical and economic potential for EE measures in buildings	15%	Percentage reduction in electricity consumption in buildings, with a payback time acceptable for building owners and users (see below)
Year to achieve 100% of the potential savings in buildings	2031	
Simple payback time for EE measures in buildings acceptable to building owners and users (years)	5	Number of years necessary for the energy savings to pay for EE measures
Parameters and objectives for EE in industry		
Percentage of national electricity consumption in industry (in base year)	20%	Includes all industrial activities (transformation of matter), including artisanal activities, treatment of minerals, agro-industrial activities, etc.
Technical and economic potential for EE measures in industry	15%	Percentage reduction in electricity consumption in industry, with an acceptable payback time
Year to achieve 100% of the potential savings in industry	2029	
Simple payback time for the EE measures acceptable to industrial enterprises (years)	3	Number of years necessary for the energy savings to pay for EE measures
Parameters and objectives for EE in public lighting		
Percentage of national electricity consumption for public street lighting (in base year)	1%	
Technical and economic potential for EE measures in public street lighting	20%	Percentage reduction in electricity consumption for public street lighting with an acceptable payback time (see below)
Year to achieve 100% of the potential savings for public street lighting	2024	
Simple payback time for the EE measures acceptable to municipalities/street light operators (years)	4	Number of years necessary for the energy savings to pay for EE measures
Parameters and objectives for cooking		

Year to reach 100% of households with access to clean, affordable, safe and sustainable cooking	2031	
Percentage of families using LPG for cooking (base year)	10%	
Cost per family of equipment for LPG cooking (Liberian Dollar)	100	Average cost per family for all types of equipment: individual (bottle/tank, cooking appliance/hot plate); collective (filling station, distribution network, tanks, etc.)
Lifetime of LPG cooking equipment (years)	10	Average lifetime of the different types of equipment
Target for the percentage of families using LPG, when the 100% access to modern cooking target is achieved	45%	
Percentage of families using improved stoves (wood, charcoal) for cooking (in base year)	15%	
Cost per family for an improved wood/charcoal stove (Liberian Dollar)	10	
Lifetime of an improved cookstove (years)	10	
Target for the percentage of families using improved Cook-stoves, when the 100% access to modern cooking target is achieved	50%	
Percentage of families using an alternative modern cooking technology (in base year)	1%	Modern cooking technologies include: biogas, ethonal, pellets, solar stoves, etc.
Cost per family of alternative modern cooking technology (Liberian Dollar)	50	
Lifetime of alternative cooking technology	10	For all types of alternative technologies that are targeted in national plans
Target for percentage of families using alternative modern cooking technologies, when the 100% access to modern cooking target is attained	5%	
Automatic check of targets	Plan OK	Automatic verification: the sum of targets for LPG, improved stoves and alternative technologies = 100% (note: unless the national plans aim at a target lower than 100% within the scenario period)

The End; Thank You.